MONTHLY WEATHER REVIEW.

Editor: Prof. CLEVELAND ABBE. Assistant Editor: HERBERT C. HUNTER.

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The MONTHLY WEATHER REVIEW summarizes the current manuscript data received from about 3,500 land stations in the United States and about 1,250 ocean vessels; it also gives the general results of the study of daily weather maps based on telegrams or cablegrams from about 200 North American and 40 European, Asiatic, and oceanic stations.

The hearty interest shown by all observers and correspondents is gratefully recognized.

Acknowledgment is also made of the specific cooperation of the following chiefs of independent, local, or governmental services: R. F. Stupart, Esq., Director of the Meteorological Service of the Dominion of Canada; Señor Manuel E. Pastrana, Director of the Central Meteorological and Magnetic Observatory of Mexico; Camilo A. Gonzales, Director-General of Mexican Telegraphs; Capt. I. S. Kimball, General Superintendent of the United States Life-Saving Service; Commandant Francisco S. Chaves, Director of the Meteorological Service of the Azores, Ponta Delgada, St. Michaels, Azores; W. N. Shaw, Esq., Director Meteorological Office, London; Maxwell Hall, Esq., Government Meteorologist, Kingston, Jamaica; Rev. L. Gangoiti, Director of the Meteorological Observatory of Belen College, Havana, Cuba; Luis G. y Carbonell, Director, Meteorological Service of Cuba, Havana, Cuba; Rev. José Algué, S. J., Director of the Weather Bureau, Manila Central Observatory, Philippines; Maj. Gen. M. A. Rykachef, Director of the Physical Central Observatory, St. Petersburg, Russia; Carl Ryder, Director, Danish Meteorological Institute, Copenhagen, Denmark.

As far as practicable the time of the seventy-fifth meridian is used in the text of the MONTHLY WEATHER REVIEW.

Barometric pressures, both at land stations and on ocean vessels, whether station pressures or sea-level pressures, are reduced, or assumed to be reduced, to standard gravity, as well as corrected for all instrumental peculiarities, so that they express pressure in the standard international system of measures, namely, by the height of an equivalent column of mercury at 32° Fahrenheit, under the standard force, i. e., apparent gravity at sea level and latitude 45°.

FORECASTS AND WARNINGS.

By Prof. E. B. GARRIOTT, in charge of Forecast Division.

Unseasonably low temperature in middle and eastern districts of the United States, with frost in the interior of the Gulf and South Atlantic States and snow in the upper Ohio Valley, marked the opening of May. Over the Azores, where the barometer had been exceptionally low during the last five days of April, pressure continued below 30.00 inches until May 9. In the Iceland area, where pressure had been high during the last half of April, the barometer continued above 30.00 inches until May 6.

A depression that occupied the Lake Superior region on the 1st advanced over Canada and the Atlantic and reached the British Isles on the 6th, its passage over the ocean being attended by strong gales. A depression that appeared on the north Pacific coast on the 1st moved over the Plateau and Rocky Mountain districts during the 2d and 3d, drifted slowly over the central valleys from the 4th to the 7th, occupied the Atlantic coast from the 9th to the 11th, and reached the British Isles on the 14th. Depressions that leave the American coast at this season of the year usually advance toward and merge into the great Iceland low area. The southern course of the two depressions, here referred to, was due to the prevalence of abnormally high pressure over Iceland and persistent low pressure over the Azores. The depressions, advancing along the line of least resistance, were deflected to the southward of the usual path.

The depression that crost the American Continent during the first decade of the month was attended by exceptionally heavy rains in localities in the Gulf and Atlantic States, and the middle Mississippi and Ohio valleys, and was followed by snow and freezing temperature in the middle and northern Rocky Mountain districts and thence over the northern portion of the Lake region. Its slow advance was apparently due to the persistent and abnormal distribution of atmospheric pressure over the Atlantic and western Europe above referred to.

The Cheyenne Tribune, of May 4, 1908, has the following editorial concerning a forecast issued at Washington, D. C., May 2, for the following week:

> The weather man down at Washington has made an excellent guess. Saturday he gave to the Associated Press the following:
>
> The rains of the week beginning Sunday, May 3, will cover the principal agricultural districts from Canada to the Gulf of Mexico. From May 3 to 5 an area of general rains will advance from the Pacific to the Atlantic coasts, reaching the Atlantic coast Monday night or Tuesday. * * *
>
> The storm Cheyenne is now enjoying arrived promptly as scheduled and is worth more to Laramie County than can be measured in dollars and cents. The precipitation is probably general over Wyoming.

The rains referred to broke a drought in Wyoming and eastern Colorado that was becoming serious.

A barometric depression that apparently crost the southern California coast on the 10th and 11th advanced slowly eastward over the Plateau and Rocky Mountain districts and northeastward over the Great Plains and north-central valleys from the 11th to the 15th, attended by exceptionally heavy rains and severe local storms in Louisiana and Arkansas on the 12th, and in Louisiana, eastern Texas, and Arkansas on the 13th. On these dates also heavy rains fell in parts of Nebraska, Missouri, Iowa, Illinois, and Indiana.

From the 13th to 15th an area of high barometer, attended by unseasonably cool weather, advanced from Manitoba to the north Atlantic coast, and the barometer continued high in the northeast until the 19th, when an area of low barometer that appeared over Nevada on the 14th reached that region.

The week beginning Sunday, May 17, opened with high barometric pressure over southern and low pressure in northern latitudes of the Northern Hemisphere, a distribution that indicated for the following seven days temperature about or above the seasonal average with showery weather over the middle and northern sections and settled fair weather over the Southeastern States of the United States. A justified forecast to this effect was issued on the 18th.

On the 19th and 20th a barometric depression covered the Rocky Mountain districts and low pressure, with extensive areas of local rains and thunderstorms, covered the western interior river valleys during a great portion of the third decade of the month. In the Southwestern States the rains of this

period were exceptionally heavy and resulted in devastating floods in Texas and Oklahoma. The persistent low pressure over the interior caused in the Eastern States a continuation of southerly winds and abnormally high temperature until the arrival in that section of a disturbance that appeared near Santo Domingo, W. I., on the 24th. This disturbance arrived off the North Carolina coast on the 29th, reached the neighborhood of New York, N. Y., the night of the 30th, and past thence northeastward over the Canadian Maritime Provinces. The gales that attended its passage along the Carolina and middle Atlantic coasts were severe, and due and timely notice was given of their occurrence.

Following the northeastward passage of the West Indian storm an area of high barometer and cool, fair weather advanced from the British Northwest Territory over the Lake region and north-central valleys at the close of the month.

During the last six days of the month a barometric depression, a typhoon, apparently advanced from west of Luzon, Philippine Islands, toward the Japanese coasts.

BOSTON FORECAST DISTRICT.*
[New England.]

The month was warmer than usual and there was more than the usual amount of precipitation. The first decade of the month was cool and temperature was generally above the normal during the remainder of the month. On the 2d and 3d temperature thruout the section was near or slightly below freezing, and on the 26th maximum readings between 85° and 90° were noted. Storm warnings were displayed on the 6th and 30th, and were fully justified. There were no storms for which warnings were not ordered.—*J. W. Smith, District Forecaster.*

NEW ORLEANS FORECAST DISTRICT.*
[Louisiana, Texas, Oklahoma, and Arkansas.]

The first decade of the month was cool and frost, for which warnings were issued, occurred in the northwestern part of the district on three dates. During the latter half of the month temperature was above normal. No general storms occurred on the Gulf coast and no storm warnings were issued.—*I. M. Cline, District Forecaster.*

LOUISVILLE FORECAST DISTRICT.*
[Kentucky and Tennessee.]

The month opened cold, with heavy frost in Kentucky and northern Tennessee and light frost in southeastern Tennessee the morning of the 1st. Abnormally cold weather in the first decade was followed during the balance of the month by abnormally high temperature. Rainfall was about normal in Kentucky and below normal in Tennessee. No special warnings were issued.—*F. J. Walz, District Forecaster.*

CHICAGO FORECAST DISTRICT.*
[Indiana, Illinois, Michigan, Wisconsin, Minnesota, Iowa, Missouri, North Dakota, South Dakota, Nebraska, Kansas, and Montana.]

Rainfall was exceptionally heavy over the greater portion of the district. During the early part of the month temperature was considerably above normal, while later it was above normal in the eastern and below in the western portions. Storm warnings were issued to upper Lake ports several times during the month, and while the warnings were, as a rule, verified there were no exceptionally severe storms, except in the case of a few thundersqualls. Verified frost warnings were issued during the first decade, and again during the third decade for a few of the Northwestern States.—*H. J. Cox, Professor and District Forecaster.*

DENVER FORECAST DISTRICT.*
[Wyoming, Colorado, Utah, New Mexico, and Arizona.]

In northern Utah and parts of Wyoming rainfall was heavy. At Salt Lake City the amount was the greatest of record for May. Temperature was lower than usual and frost was frequent, except in extreme southern portions of the district. Warnings of the frosts were given in the regular forecasts, and for severe frosts and freezing temperatures general and more effective distributions were made. As a result of heavy rainfalls, rivers in Wyoming reached high stages. Owing to the light winter snowfall and cool weather, stages in the Colorado and Rio Grande rivers were much lower than usual, while discharges from the Arkansas and South Platte rivers were insufficient to meet the needs of irrigation enterprises.—*F. H. Brandenburg, District Forecaster.*

SAN FRANCISCO FORECAST DISTRICT.†
[California and Nevada.]

The month began with unsettled weather that was followed thru the first decade by fair weather. The second decade of the month was unsettled and unusually cold. Very high northwest winds were frequently reported along the coast from Point Reyes northward.—*A. G. McAdie, Professor and District Forecaster.*

PORTLAND, OREG., FORECAST DISTRICT.†
[Oregon, Washington, and Idaho.]

The month was marked by excessive cloudiness and unseasonably low temperature. On the 1st warnings were issued for a storm that past over the district on the 2d. Light frosts were of frequent occurrence but were of a local character, except on the 13th, 17th, and 23d, when they were general over the eastern portion of the district.—*L. Lodholz, Local Forecaster, temporarily in charge.*

RIVERS AND FLOODS.

The morning weather map of May 21 showed a depression over western Texas, and a moderate high area over the lower Missouri Valley. During May 22 and 23 the depression moved slowly eastward over southern Texas, and relatively high pressure continued to the northeastward and eastward. On the morning of May 24 the Texas depression had about disappeared, but there was another over northern New Mexico, with a high area over Lake Superior. During the 22d heavy rains fell in the Texas Panhandle, Oklahoma, and the extreme northern portion of eastern Texas. These heavy rains continued during the night of the 22d and extended into the upper watersheds of the Brazos and Trinity rivers, 4.44 inches falling at Abilene, Tex., during the night of the 22–23d. More heavy rains fell in Oklahoma and that portion of the Red River Valley immediately to the southward, continuing during the night of the 23d at an excessive rate, and extending thruout Texas generally. During the twenty-four hours ending at 8 a. m., May 24, the precipitation over eastern Texas ranged from 1½ to over 6 inches. On the morning of the 25th there was a well-defined depression over the Dakotas and Nebraska, and the rains in Texas had ceased. The following map (fig. 1) shows the amount and distribution of the rainfall over the State of Texas from May 21 to 24, inclusive.

Such torrential downpours could have but one result, and the floods that followed were the greatest and most destructive ever recorded in the history of the State of Texas. Over the watershed of the Colorado River the rainfall was not as heavy as over the watersheds of the Brazos and Trinity rivers, and the rise in the former river was not important except below Austin. At Columbus the maximum stage was 33.8 feet on the 30th, 9.8 feet above the flood stage, but no flood stages were reported from places any considerable distance above.

Owing to the excessive rate at which the rain fell on the 23d the first rush of flood waters in the Brazos and Trinity rivers came very suddenly. At Kopperl, on the Brazos River, 60 miles above Waco, the gage reading on the morning of May 23 was only 1.2 feet, but by the morning of the 24th it

* Morning forecasts made at district center; night forecasts made at Washington, D. C.
† Morning and night forecasts made at district center.

was 22 feet, or 1 foot above the flood stage, showing a rise of 20.8 feet in twenty-four hours. At 8 p. m., of the same date, a record-breaking crest stage of 34 feet was reached, making a total rise of 32.8 feet in about thirty-eight hours, a most remarkable rise for so large a river. By the morning of the 25th the river had fallen to 21.6 feet. There was a secondary rise of about 5 feet on the 26th and 27th, after which there was a rapid decline. At Waco there was a rise of 28.7 feet from 6 a. m. of the 23d to 2:40 p. m. of the 24th, at which latter time the stage of water was 36.7 feet, 12.7 feet above flood stage, and the highest stage of record, exceeding by 1.1 feet the previous high-water stage of May 28, 1885. The river remained above the flood stage until the evening of the 28th. At Valley Junction, 70 miles below Waco, the river past the flood stage of 40 feet during the 25th, reaching a crest stage of 50.9 feet on the 27th. At the end of the month the river was still rising from Hempstead southward, with stages closely approximating the flood stage.

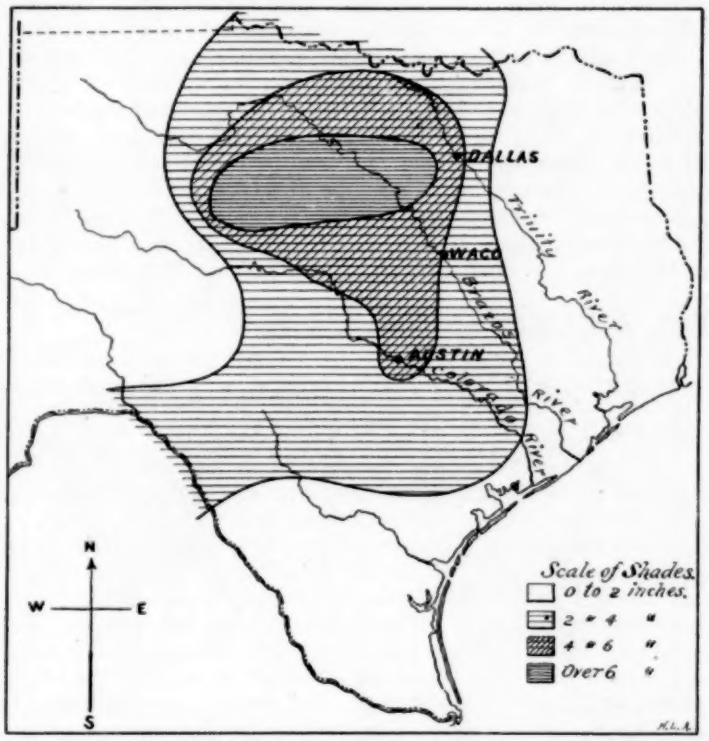

FIG. 1.—Rainfall distribution in Texas, May 21 to 24, inclusive.

The behavior of the Trinity River was very similar to that of the Brazos, but the flood was of greater proportions and much more destructive. At Dallas, at 6 a. m. of the 22d, the river stood at 10.5 feet; it past the flood stage of 25 feet during the early morning of the 24th, and crested at 52.6 feet at 6 p. m. of the 25th, with a total rise of 42.1 feet, and a crest stage only 3.9 feet below the great stage of June, 1866. At the end of the month the river was still above the flood stage. Below Dallas the rise was not so great, altho flood stages were general, exceeding in many places the highest stages previously recorded. From Long Lake southward a second pronounced rise set in on the 28th, and it was still in progress at the close of the month.

The upper Neches River was also affected by the heavy rains, and at Rockland it was above the flood stage of 20 feet from the 20th until the end of the month, with a crest stage of 25 feet on the 25th. This is the highest stage of record.

The upper Sabine River was in flood from the 15th until after the end of the month on account of heavy rains that fell from the 12th to the 17th, inclusive. The crest stages, however, were not unusual.

The Guadalupe and other smaller rivers of southeastern Texas also contributed to the general disturbance, but not to an alarming extent.

The usual difficulty has been encountered in obtaining data regarding the losses of life and property by this flood. It is known that at least 8 persons were drowned at Dallas, and 3 at or near Fort Worth. Nearly 5,000 persons were driven from their homes in Dallas, and 600 houses were vacated at Fort Worth, household effects being left behind and ruined in most instances. Other losses were those usually incident to great floods. Roughly speaking, the actual losses at Dallas amounted to $1,500,000, and at Fort Worth, $500,000. This is exclusive of railroad losses which must have amounted to at least $500,000, and of commercial losses occasioned by the blocking of freight and the suspension of business. With the losses outside the two cities considered, the total from all causes must be not less than $5,000,000.

The heavy rains from the 22d to the 24th, inclusive, also extended into Oklahoma, Oklahoma City reporting a total precipitation of 6.96 inches during the forty-eight hours ending at 6 a. m. of the 24th. Practically every stream in the State was above flood stage; many were higher than ever before, and the flood, considered as a whole, was probably the greatest in the history of the State. A number of lives were lost, and the property losses were enormous. Farm lands and houses were submerged, railway bridges and roadbeds and highway bridges and roads were carried away or washt out, gas mains were broken, plunging cities into darkness, and manufacturing plants were demolished. Owing to the fact that organized flood service is not maintained over the greater portion of Oklahoma, it has been impossible to obtain detailed statements of the losses occasioned by the floods. They must have amounted to several millions of dollars, not including the very large amounts necessary for repairs and reconstruction and the losses suffered thru the enforced cessation of business of every nature.

While the floods did not extend north of the Oklahoma-Kansas line, they extended eastward into the lower Neosho, lower Canadian, and the Arkansas rivers. At Calvin, Okla., on the Canadian River, the highest stage reached was 17.2 feet, 7.2 feet above the flood stage. The Neosho River from the Kansas line southward was above flood stage from the 24th to the 27th, inclusive, with a maximum stage at Fort Gibson, Okla., near the mouth of the river, of 35 feet on the 25th, 13 feet above the flood stage.

The Arkansas River went above the flood stage of 16 feet at Tulsa, Okla., on the 24th, and by the 28th the first flood tide had reached Pine Bluff, Ark. The greatest rise occurred in the heavy rain belt between Webbers Falls, Okla., and Fort Smith, Ark., where the crest stages were from 9 to 11 feet above the flood stage. Warnings of this flood were issued in ample time, except along the lower Canadian River, where the suddenness of the rise prevented an effective warning. Reports received indicate that the warnings were of great value and were the means of saving a large amount of property. Movable property to the value of about $250,000 was saved, and the strengthening of levees upon advices given by the Weather Bureau prevented the overflow of several thousands of acres of growing crops. The principal losses were to crops, mills, and cut lumber. River business was, of course, suspended and it was not actually resumed until June 19. The money value of property saved was about $1,000,000, one-half above, and one-half below Fort Smith. The losses and damage amounted to about $250,000, 90 per cent of which was suffered by the farmers, and to these figures should be added a further loss of about $75,000 occasioned by the suspension of business. As far as could be learned, no material damage was done to farm lands by erosion or deposit.

The rise in the lower Arkansas River was not so great and

this fact, together with the timely warnings, prevented any damage of consequence.

The Black and lower White rivers of Arkansas were above flood stage thruout the month, and there was also a decided flood in the upper White River about the middle of the month.

When the great Red River flood began on the 25th, the more moderate one of the middle of the month was still in progress east of the Arkansas line. The great flood was in full progress at the close of the month, and a report thereon will appear in the MONTHLY WEATHER REVIEW for June, 1908.

Rains in the Kansas, Missouri, and Mississippi valleys were frequent and heavy, causing general rises in the rivers, but at the end of the month floods had not set in, except in the Mississippi River between Keokuk, Iowa, and Hannibal, Mo., and in some of the upper tributaries of the Mississippi, especially the St. Croix, Minnesota, and Illinois rivers. Warnings were issued at the proper times for these floods. The rise in the vicinity of Keokuk was mainly from the Des Moines River, and while considerable damage was done to crops, principally thru the breaking of a small private levee between the Des Moines River and the town of Alexandria, Mo., a four-inch deposit of rich soil offset the losses.

The lower Mississippi River was uniformly high, altho not dangerously so, except from New Orleans, La., southward.

The rise that began about the 7th in the upper Ohio River and tributaries did not result in flood stages, except from Evansville, Ind., to Cairo, Ill., where the flood lines were slightly exceeded. Not much direct damage was done, but farming operations, especially corn planting, were greatly delayed. Heavy rains from the 4th to the 6th, inclusive, also caused moderate floods in the Scioto and Great Miami rivers of Ohio, and the warnings issued for the same were fully verified. The damage done was not extensive.

The Grand River of Michigan was in moderate flood from the 9th to the 24th, inclusive. Advices were given when necessary, and there were no unpleasant features, except some slight inconvenience in the lowlands.

The rivers of the Gulf of Mexico system east of the Mississippi River were in flood during the early days of the month as a result of heavy general rains during the last few days of April. In fact the lower Flint and lower Chattahoochee rivers were already in flood at the beginning of May. Flood warnings were issued for the Flint, Chattahoochee, and Apalachicola rivers on April 27, and they were reported to have been of much value to the lumber, cattle, and mill interests. Floods of a similar character occurred in the Black Warrior and lower Tombigbee rivers, and in the Pascagoula and Pearl rivers of Mississippi, for which warnings were issued when indicated.

The Columbia River continued to rise thruout the month.

The highest and lowest water, mean stage, and monthly range at 215 river stations are given in Table IV. Hydrographs for typical points on seven principal rivers are shown on Chart I. The stations selected for charting are Keokuk, St. Louis, Memphis, Vicksburg, and New Orleans, on the Mississippi; Cincinnati and Cairo, on the Ohio; Nashville, on the Cumberland; Johnsonville, on the Tennessee; Kansas City, on the Missouri; Little Rock, on the Arkansas; and Shreveport, on the Red.—*H. C. Frankenfield, Professor of Meteorology.*

SPECIAL ARTICLES, NOTES, AND EXTRACTS.

WEATHER INFLUENCES PRECEDING THE EVACUATION OF BOSTON, MASS.[1]

By WALTER N. LACY. Dated Harvard University, May 11, 1908.

In a recent study of some climatic influences on American history the writer found reference to the weather conditions which played an important part in the closing history of the siege of Boston. A careful investigation of all available data on the subject led to the preparation of this paper and of the accompanying maps of the probable weather conditions in the vicinity of Boston for March 4, 5, and 6, 1776. The maps were drawn from the available data of the local weather conditions at the time and upon present knowledge of the nature, tracks, and velocity of storms in the eastern part of the United States. (See fig. 1.)

Following the battle of Bunker Hill and the arrival of General Washington as Commander-in-Chief in the summer of 1775, the continental forces kept a blockade around the city of Boston all thru the following winter. As spring advanced Washington resolved upon some effective move, and with the consent of his officers prepared to fortify Dorchester Heights, a position which so commanded Boston and the harbor as to make untenable the British position as long as the Americans occupied those heights. During the first few days of March, 1776, preparations were hurried for effecting Washington's plan, and on the nights of Saturday and Sunday, March 2 and 3, cannonading was kept up by the continental forces from Lechmeres Point, Cobble Hill, and Lambs Dam, Roxbury, near the present lead works on Albany street. (See the accompanying sketch map, fig. 2.)

[1] Part of a thesis prepared in the course in advanced climatology given by Prof. R. DeC. Ward, in Harvard University, during the year 1907–8. The references consulted in the preparation of this paper include histories of the United States, the Revolutionary War, and Boston; a memorial address on the Centennial of the Evacuation, by George E. Ellis, D.D.; published letters or journals of Lieut. William Carter of the British Army, George Washington, and Daniel McCurtin; manuscripts by Timothy Newell, Doctor Holyoke, and Professor Winthrop; and Prof. Edward B. Garriott's "Cold Waves and Frost in the United States." Grateful mention must also be made of the suggestions received from Mr. J. W. Smith, District Forecaster at Boston, Mass.

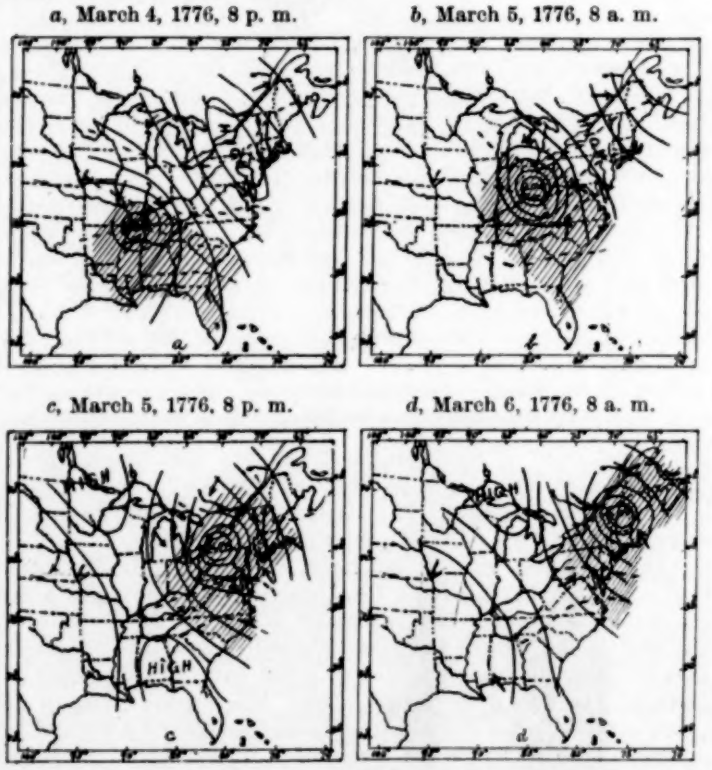

FIG. 1.—Maps showing probable weather conditions in eastern United States during operations preceding evacuation of Boston, Mass.

Monday evening, March 4, everything was in readiness and the night was unusually favorable for the execution of Washington's plan. Between 7 and 8 o'clock some two thousand men, including a covering party, moved toward Dorchester Heights, under command of General Thomas. The ground, to a depth of some 18 inches, was frozen so hard that it could not be thrown up as breastworks, and fascines and

chandeliers (wooden frames) were carried by the American troops with which to erect their fortifications. Altho the ground was frozen, yet by reason of a southwest wind the night was "remarkably mild," and the light of the full moon aided the men in their work. A light haze, or perhaps a radiation fog with the moist southwest wind, combined with the smoke from the cannonading which the Americans had commenced earlier in the evening, settled down over the town and the lowlands and concealed the progress of the work on the heights.

FIG. 2.—Sketch map of Boston with its environs in 1775 and 1776. (From Frothingham's History of the Siege of Boston.)

The cannonading of the night, the southwest wind carrying any sound of the American operations out toward the bay, and the smoke and fog kept the British from any suspicion of what Washington's men were doing, so that when morning broke Howe's men were much surprised to find what the Americans had accomplished during the night. Looking thru the early morning fog, the fortifications "seemed of indefinite magnitude," and both General Howe and Admiral Shuldham realized that their positions were insecure as long as the Americans remained on Dorchester Heights. Consequently General Howe decided to prepare to attack, and about noon between two and three thousand men, under command of General Jones, began to embark in transports. The plan was for them to drop down in the late afternoon or early evening to Castle Island, whence they could cross to the cove southeast of the American position and attack the Americans from the rear early Wednesday morning.

Tuesday morning had dawned clear and mild, with a bright sun and a warm southerly wind. During the afternoon, however, the storm which had been indicated by preceding fog and winds, and which had probably been advancing up the Ohio Valley, must have reached New York State. A marked low-pressure area there would have produced strong southeast winds in the vicinity of Boston. In the afternoon the wind blew furiously, so billowing the harbor that three of the transports were blown upon Governors Island before reaching the Castle. By night a "rank storm," as one of the British officers called it, had set in with a fury "such as few remember to have heard," and the rain fell in torrents, so drenching the Americans who had all day continued to strengthen their position, that one of them wrote in his journal "I never before felt such cold and distress as I did this night, and I believe it was the case in general with our men."

As morning drew near there was no abatement of the storm, and Wednesday, March 6, commenced amid torrents of rain and a boisterous wind from the southeast. The center of the storm had probably past into northern Vermont or New Hampshire, and with the furious southeast gale that was blowing, such a surf beat upon the Dorchester shore where the troops must have landed, that "an attempt to land must have proved fatal."

Altho the rain and the wind continued the greater part of Wednesday with little less fury the time was not being lost by the men under General Thomas. When the storm and the surf had sufficiently subsided for the British to attack, they realized that the American position was too strong for them, and by night (Wednesday, March 6) the evacuation of Boston had been decided upon. Eleven days later the city was abandoned, and the entire force under General Howe dropt down in their transports toward Nantasket, sailing thence for Halifax ten days later.

Of the British plan and the results of the storm General Washington wrote Major-General Lee on March 14, as follows:[2] "A very heavy storm of wind and rain frustrated their design; in my opinion the most fortunate circumstance for them and unfortunate for us that could have happened, as we had every thing so well prepared for their reception that I am confident we should have given a very good account of them." Whether Washington was right, and whether the British must have evacuated the city had they attacked, will never be known; but it seems certain that the closing chapter of the siege of Boston would have been different had the weather not frustrated General Howe's plans.

THE WORK OF PROF. CARL STÖRMER ON BIRKELAND'S THEORY OF THE AURORA BOREALIS.

By JOHN A. ANDERSON, Ph. D. Dated Johns Hopkins University, Baltimore, Md., May 29, 1908.

The general appearance of the streamers, bands, etc., of the aurora borealis is so similar to some of the phenomena accompanying the passage of cathode rays thru rarified gases that most of the modern theories which aim to account for it assume that the aurora is produced by cathode rays passing thru the upper atmosphere. The altitude at which the aurora appears (about 40 miles), where the atmospheric pressure is about what is commonly found in our vacuum tubes, tends to support this view as to the cause of the luminous phenomena observed. Another fact also pointing to the same conclusion is that the streamers increase in intensity downward, which is what we should expect since cathode rays are more strongly absorbed the greater the pressure of the gas thru which they pass, and hence with increase of pressure the luminosity of the air caused by them should increase up to very near the point where they are completely absorbed.

The theories of the aurora accordingly differ chiefly in the way in which they account for the origin of the cathode rays. The fact that great auroras very frequently are seen at a time when some sun spot is showing unusual activity has led to the general belief that the first cause of the aurora is to be sought in the sun.

There are three theories which seem to be able to account in a more or less satisfactory manner for the chief characteristics of the aurora. These are (1) the theory of Arrhenius (Ofversigt, 1900); (2) the theory of Nordmann; (3) the theory of Birkeland (Archives, 1896).

(1) Arrhenius's theory assumes that the sun sends out negatively charged particles (larger than atoms) which, repelled by light pressure, reach our atmosphere, where they are discharged by ultra-violet light from the sun, thus giving rise to cathode rays, which move in spirals around the magnetic

[2] Jared Sparks: The Writings of George Washington. Vol. III. (Hilliard, Gray & Co. Boston. 1834.)

lines of force until they have penetrated sufficiently deep into the atmosphere to be absorbed, when they give rise to the luminosity observed.

(2) The theory of Charles Nordmann assumes that electrical disturbances accompanying sun spots and prominences on the sun give rise to Hertzian waves, which, on being absorbed in the rarified upper layers of our atmosphere, give rise to cathode rays, which then move along the lines of force and produce the aurora as in the theory of Arrhenius.

(3) Birkeland assumes that the cathode rays emanate from the sun directly, and most copiously from the sun spots. On approaching the earth they are directed into certain definite channels by the terrestrial magnetic field, and on striking the atmosphere they set up electrical currents there, which in turn send out cathode rays. These "secondary" cathode rays are then responsible for the aurora as in the other theories. Auroras might also be caused directly by the cathode rays from the sun.

Birkeland supported his theory by some experiments with a vacuum tube; in the path of the cathode rays from this tube he placed a small spherical electromagnet whose surface was covered with a layer of platinobarium cyanide. The small magnet could be rotated about an axis which made a small angle with its magnetic axis, and was so wound that its magnetic field represented that of the earth as closely as possible.

On magnetizing the sphere he found that the luminosity, instead of being uniform over the side facing the cathode, was limited to certain regions only. There was usually a ring of luminosity nearly coincident with the equator; also a ring surrounding each magnetic pole, which with a certain relation between the cathode fall of potential and the magnetic field due to the sphere, had a radius of about 20°. Besides these, certain other rings appeared having their centers between the equator and the poles.

Birkeland believed that the cathode rays produced currents in the gas surrounding the sphere, and that the luminosity observed on the surface of the sphere was due to cathode rays sent out from these currents.

Applying these results to the case of the earth and the sun he concluded that cathode rays sent out from the sun, on coming within the influence of the earth's magnetic field, are directed into paths similar to those observed in his experiments. Electric currents in our upper atmosphere are thus produced which disturb the earth's magnetic field, and also give rise to cathode rays producing the auroral displays.

In a paper entitled "Sur les trajectoires des corpuscules electrisés dans l'espace sous l'action du magnétisme terrestre avec application aux aurores boréales,"[1] Prof. Dr. Carl Störmer, of Christiania, derives mathematical expressions by means of which the path of a cathode particle sent out from the sun in the direction of the earth may be calculated. This is an extension of the problem solved by H. Poincaré of finding the path of a cathode particle acted on by a single magnetic pole, inasmuch as it supposes the particle acted on by a magnetic doublet.

In order to simplify the treatment as much as possible, he supposes the earth's magnetic field replaced by one due to a doublet of moment 8.52×10^{25}, supposed to be placed at the earth's center.

He finds that the dimensions of the paths are determined by the value of $\sqrt{\frac{M}{H_0 \rho_0}}$, where

M = magnetic moment of the doublet, and

H_0 = strength of the magnetic field in which a charged particle of given mass and velocity would move in a path whose radius of curvature is ρ_0.

For the earth M is fixt. Hence the size of the paths depends upon the value of the product $H_0 \rho_0$, that is, upon the nature of the cathode rays.

The observations of Birkeland are accounted for in a satisfactory manner since he finds that the paths observed by him are all found among those calculated, by assuming different values for certain consonants in the equation.

The appearance of the aurora on the night side of the earth is shown to follow at once provided $H_0 \rho_0$ has such values as correspond to cathode rays or to β-rays from radium. It seems impossible, however, that the heavier charged particles required by Arrhenius's theory could be deviated sufficiently to strike the atmosphere in any place except on the day side. Rays sent out from the sun, in order to strike the earth must be sent out in a definite direction with respect to the earth's magnetic axis. If the center of emission is some sun spot or facula which sends out a rather narrow conical beam, this could strike the earth for only a short time owing to its diurnal rotation, which would soon change the position of the earth's magnetic axis relative to the axis of the cone of cathode rays. On the following day, when the earth's magnetic axis would again occupy the same position relative to the sun, the sun itself would have turned thru an angle of about 15°, and accordingly if the beam is narrower than this no cathode rays would strike the earth. If, on the other hand, the source on the sun sends out rays in all directions inside a cone of considerable angle, it follows that the disturbance on the earth might be repeated on several successive days, and at about the same hour each day. This has frequently been observed to be the case with auroras. Störmer also shows that a source of limited area may produce auroral streamers, or an auroral band, according to the nature of the rays and the direction in which they are emitted. His calculations for the actual dimensions of the bands agree quite well with those observed.

The diameter of the zone of maximum frequency is also calculated for the various values of the product $H_0 \rho_0$; but the value comes out too small, being only from 2° to 5° for cathode rays and β rays of radium, while the actual diameter is something like 20°. Störmer thinks this discrepancy is due to his assumption that the earth's magnetic field may be regarded as due to a doublet at the center of the earth, and that it will disappear when calculations are made using the actual magnetic field of the earth.

The calculations are all very laborious, as the paths must be found by quadratures, the author not having succeeded in integrating his equations up to the time of writing the paper. The results of the more exact calculations will be awaited with interest, as the theory seems very promising.

If these more exact calculations give results which are in substantial agreement with observations, as Doctor Störmer seems to expect, Birkeland's theory will have to be considered as perhaps the most important of the theories of the aurora that have been proposed up to the present time.

An interesting question which arises in connection with this theory, and one which has furnished the strongest objection to it, is the origin of the cathode particles and their escape from the sun.

There are a number of ways in which it is known that cathode particles or negative electrons may be set free, the chief of which are—

1. Ionization of a rarified gas by strong electric fields, such as exist near the cathode in an ordinary vacuum tube.
2. Radio-active bodies, such as radium, thorium, actinium, and their products, some of which are continually emitting these particles at very high velocities.
3. Action of ultra-violet light on substances, especially the metals. Some substances become active even when acted on by light in the visible spectrum.
4. Incandescent solids, or very hot bodies in general.
5. Secondary cathode rays are usually emitted by substances

[1] Archives des Sciences Phys. et Nat., July-Oct., 1907.

upon which so-called primary cathode or β rays fall. The primary rays may be produced by any of the methods given above. The secondary rays may, by impinging on substances, give rise to tertiary rays, and so on.

To these may be added another way, which has been described by Professor Birkeland, namely, that cathode rays are sent out from a rarified gas when it is traversed by an electric current. This was demonstrated by means of a vacuum tube consisting of a large spherical bulb with two tubes of small bore sealed into it at right angles to each other and situated 90° apart on a great circle of the sphere. The electrodes were sealed into these tubes, and hence when a discharge was past the current entered the large bulb from the small opening in one of these tubes and had to leave it thru the similar opening of the other, the object being to get a current that should be confined to only a limited portion of the gas in the bulb. One of the tubes projected some distance into the bulb, and the path of the current when no magnet was brought near the bulb was approximately a straight line between the openings in the two tubes. With a suitably high vacuum a faint glow was seen thruout the whole volume of the bulb, besides the comparatively brilliant path of the current, and the walls of the bulb phosphoresced with a faint yellow light, indicating that they were being bombarded with cathode particles.

On bringing one pole of a very powerful electromagnet near the bulb, the path of the current was bent into a curve, and the glow which before filled the bulb was drawn up into a band whose surface contained the curved current and also the lines of magnetic force. These phenomena indicate that the cathode particles were sent out from the gas in the path of the current, and in a magnetic field their paths would, of course, be spirals around the lines of force.

The most natural assumption to make regarding the origin of the cathode rays sent out from the sun is that they are emitted by the photosphere itself since this is undoubtedly at a very high temperature. The objection to this is that such cathode rays could perhaps never penetrate the deep solar atmosphere which they would have to do in order to reach the earth. We do not know how dense the solar atmosphere is, but most estimates agree that near the photosphere it is very much denser than that of the earth, and since the β rays of radium, which are far more penetrating than ordinary cathode rays, are completely absorbed by a layer of gas of much smaller extent than our atmosphere, it follows that the solar atmosphere would effectually stop any negative electrons emitted by the photosphere.

Evidently, then, the source of the cathode rays demanded by Birkeland's theory must be lookt for high up in the solar atmosphere, where the density is extremely small. There are several ways in which cathode rays might originate even in the upper regions of the solar atmosphere where the density is sufficiently small to favor the ready escape of the particles into space. It seems, however, necessary to connect this emission of electrons in some direct way with the sun spots, or, more definitely, with the moments of great activity in a sun spot, and this limits the number of ways, by excluding the third one mentioned above. The first one is excluded because an extended rarified gas is too good a conductor to allow any strong electric fields to exist in it. The fifth may also be excluded for obvious reason.

There remain, then, the emission of cathode rays from the gas thru which a current flows, and the emission of β rays from radio-active substances. Such violent disturbances as are manifest in sun spots at times may well produce electric currents in the upper regions of the solar atmosphere, and if such currents really send out cathode rays of any considerable penetrating power, these might escape into space and so reach the earth.

Violently eruptive sun spots might also project into the upper regions of the sun's atmosphere certain radio-active material if it exists in the sun, which might emit β rays copiously enough to produce on the earth the phenomena of the aurora in accordance with Birkeland's theory.

THE WARM STRATUM IN THE ATMOSPHERE.[1]

By Prof. A. LAWRENCE ROTCH. Dated Blue Hill Meteorological Observatory, Hyde Park, Mass., April 24, 1908.

While not presuming to offer an explanation of the isothermal or relatively warm stratum in the high atmosphere which the recent letters in Nature have made known to others than meteorologists, I desire to point out that it is probably a universal phenomenon, existing at some height all around the globe. This inversion of temperature was first discovered by M. Teisserenc de Bort with the sounding balloons sent up from his observatory at Trappes, near Paris, France, in 1901, and almost simultaneously by Professor Assmann from similar German observations. Since then almost all the balloons which have risen more than 40,000 feet above central Europe (that is, near latitude 50°) have penetrated this stratum, without, however, determining its upper limit. Teisserenc de Bort early showed that its height above the earth, to the extent of 8,000 feet, varied directly with the barometric pressure at the ground. Mr. Dines[2] gives the average height of the isothermal layer above England as 35,000 feet, with extremes of nearly 50 per cent of the mean. Observations conducted last March by our indefatigable French colleague, Teisserenc de Bort, in Sweden, just within the Arctic Circle, showed that the minimum temperature occurred at nearly the same height as at Trappes, namely, 36,000 feet, altho Professor Hergesell, who made use of sounding balloons over the Arctic Ocean near latitude 75° N., during the summer of 1906, concluded that the isothermal stratum there sank as low as 23,000 feet.

During the past three years the writer has dispatched 77 sounding balloons from St. Louis, Mo , U. S. A., latitude 38° N., and most of those which rose higher than 43,000 feet entered the inverted stratum of temperature. This was found to be somewhat lower in summer, but the following marked inversions were noted last autumn: October 8, the minimum temperature of —90° F. occurred at 47,600 feet, whereas at the maximum altitude of 54,100 feet the temperature had risen to —72°; October 10, the lowest temperature of —80° was found at 39,700 feet, while —69° was recorded at 42,200 feet, showing a descent of nearly 8,000 feet in the temperature inversion within two days. The expedition sent out jointly by M. Teisserenc de Bort and the writer, on the former's steam yacht *Otaria*, to sound the atmosphere over the tropical Atlantic during the summer of 1906, launched sounding balloons both north and south of the equator within the Tropics, and altho some of these balloons rose to nearly 50,000 feet, they gave no indication of an isothermal stratum. In fact, the paradoxical fact was established that in summer it is colder 8 miles above the thermal equator than it is in winter at the same height in north temperate regions. This results from the more rapid decrease of temperature in the Tropics and the absence of the numerous temporary inversions which, as Mr. Dines has pointed out, are common in our regions below 10,000 feet. If, therefore, as seems probable, the isothermal or relatively warm stratum does exist in the tropical and equatorial regions, it must lie at a height exceeding 50,000 feet, from which height, as the data quoted show, it gradually descends toward the pole, at least in the Northern Hemisphere.

TORNADOES IN LOUISIANA, APRIL 24, 1908.

By I. M. CLINE, District Forecaster. Dated New Orleans, La., June 12, 1908.

An area of low pressure which was central over Utah on the morning of April 22 moved eastward and increased in inten-

[1] Reprinted from Nature, May 7, 1908.
[2] Nature, February 27, 1908, p. 390.

sity and geographic extent until at 8 a. m., April 24, it was central over Nebraska, covering the Great Plains and the central valleys and extending from the Great Lakes on the north to the Gulf of Mexico on the south. The weather conditions shown on the weather maps for April 23 and 24, 8 a. m., caused severe local storms in Louisiana during April 24. Two well-defined tornadoes occurred in this State along the paths shown on the map, fig. 1.

FIG. 1.—Paths of storms in Louisiana and Mississippi, and isobronts in Mississippi, April 24, 1908.

The following table shows the number of persons killed and injured, and the loss of property, including buildings, household effects, stock, and implements, in the first tornado:

Localities.	Number of people killed.	Number of people injured.	Property loss.
Lamourie	0	0	?
Richland	4	18	$2,250
Effie	0	13	2,885
Centerpoint	0	12	.....
New Era	2	8	4,000
Serena	14	Several.	5,000
Armagh	0	0	39,900
Vidalia	29	61	75 buildings and contents.
Total	40	112	About 60,000

This first tornado made its appearance in the vicinity of Lamourie, Rapides Parish, about 5 a. m. It came from the southwest and traveled toward the northeast across Avoyelles, Catahoula, and Concordia parishes, a distance of about 70 miles, and past into Mississippi at Giles Bend near Vidalia. The majority of reports state that there was a well-defined pendant funnel-shaped cloud, and rotary winds of sufficient violence to uproot trees and destroy buildings. The path of greatest destruction ranged from 300 to 700 yards in width.

The second tornado made its appearance between 11 a. m. and 12 noon in the vicinity of Weiss, Livingston Parish. The storm came from the southwest and moved toward the northeast across St. Helena, Tangipahoa, and Washington parishes, and past into Mississippi near Balltown, La. There was a well-defined pendant funnel-shaped cloud, with rotary winds of sufficient violence to uproot trees and prostrate buildings in its path. The path of greatest destruction ranged in width from one-half mile at Weiss to two and one-half miles at Amite, and covered a distance of about 80 miles in Louisiana.

The following table shows the number of persons killed and injured, and the loss of buildings, household effects, live stock, and farm implements, in the second tornado:

Localities.	Number of people killed.	Number of people injured.	Property loss.
Weiss	0	Several.	Much.
Dennis Mills	2	2	Much.
Mountpelier	2	3	$4,000
Amite	29	60	190,000
Wilmer	4	20	10,000
Aurora	0	3	10,000
Franklinton	0	8	30,000
Pine	9	18	14,000
Balltown	0	2	10,000
Total	46	116	About 275,000

Severe thunderstorms were reported from other localities in Louisiana, but reports do not indicate that there were tornadoes in other places than those named above.

TORNADOES IN MISSISSIPPI, APRIL 24, 1908.

By W. S. BELDEN, Section Director. Dated Vicksburg, Miss., May 27, 1908.

A severe thunderstorm swept southeastward over Mississippi on April 24, 1908, in connection with a well-developed and very energetic cyclone central near Concordia, Kans., on the morning of that day. Attending the advance of the thunderstorm six tornadoes were developed within the State and two moved into the State from Louisiana, both of which were very destructive to life and property.

The morning weather map of April 24 bore a striking resemblance to the morning map of March 2, 1906, the date of the Meridian, Miss., tornado in which 23 people were killed.

The accompanying chart[1] shows the southward progress of the thunderstorm and also the path, direction of movement, and the time of occurrence of each of the tornadoes. It will be noted that the thunderstorm began in the northwestern counties at about 2 a. m. and reached the Gulf counties at 6 p. m. The paths of the tornadoes varied from less than 100 yards to somewhat more than one-half mile in width, and all of these storms moved in a northeasterly direction. The rate of advance of the two that entered the State from Louisiana was approximately 35 miles per hour. In the chart we have a graphical representation of the typical relationship that exists between the thunderstorm and the tornado.

Roaring winds, severe lightning and thunder, and heavy rainfall with hail were features common to each storm.

No deaths resulted from the (*a*) Walls, (*b*) Sumner, (*c*) Anguilla, and (*d*) Braxton tornadoes. The number of deaths resulting from the other four tornadoes were as follows:

(*e*) Wahalak, 2; (*f*) Pine Ridge–Lorman, 51; (*g*) Purvis–Winchester, 97; (*h*) Epps–Janet, 5.

In Adams County 29 of the 30 killed were negroes, but in other counties the proportion of negroes killed was not nearly

[1] This chart is reproduced in combination with that prepared by Mr. Cline for the preceding article.

so great. The largest town struck by any one of the tornadoes was Purvis, located in Lamar County and having a population estimated at 2,000. At that place the killed numbered 55 and the property loss was estimated at about $500,000. A considerable portion of the property loss in the Purvis–Winchester and the Epps–Janet tornadoes was due to the destruction of thousands of large pine trees and several large sawmills.

Losses by counties.

Counties.	Storms.	Number of people killed.	Number of people injured.	Value of property loss.
De Soto	(a)	0	0	$1,500
Sunflower	(b)	0	0	2,000
Sharkey	(c)	0	0	500
Claiborne	(f)	0	4	2,000
Jefferson	(f)	21	82	75,000
Adams	(f)	30	200	45,000
Simpson	(d)	0	10	10,000
Noxubee	(e)	0	3	500
Kemper	(e)	2	6	5,000
Marion	(g)	2	15	2,000
Lamar	(g)	69	391	540,000
Forest	(g), (h)	11	75	150,000
Perry	(g), (h)	10	108	140,000
Greene	(h)	0	1	500
Wayne	(g)	19	75	50,000
Total		155	970	1,024,000

This information was obtained from 63 cooperative observers of the Weather Bureau, who are well distributed thruout the State, and from 55 postmasters located in or near the paths of the tornadoes.

TORNADOES IN ALABAMA, APRIL 24 AND 30, 1908.

By FRANK P. CHAFFEE, Section Director. Dated Montgomery, Ala., May 8, 1908.

Two destructive tornadoes past over portions of Alabama during the afternoon and evening of April 24, 1908.

The more destructive of the tornadoes extended thru portions of five counties in northern Alabama, and traveled a distance of about 125 miles in about one hour and thirty-five minutes. It began near Dora, Walker County, about 2:40 p. m., past over Warrior, Jefferson County, at 3 p. m., was next felt at Royal, Blount County, 3:30 p. m., at Wynnville, Blount County, 3:40 p. m., at Albertville, Marshall County, 4 p. m., at Tenbroek, DeKalb County, 4:10 p. m., and seems to have ended a few miles northeast of Sylvania, DeKalb County, about 4:15 p. m., as shown in fig. 1.

Fig. 1.—Path of tornado in northern Alabama, April 24, 1908.

The path of the storm varied in width from about 200 yards to half a mile, the greatest destruction being wrought where it was most constricted. While the storm was of destructive force along practically its entire path, the greatest loss of life and damage to property occurred at Bergens, near Dora, and at Albertville, half of which was practically destroyed.

A funnel-shaped cloud swept along the entire path of the storm. The cloud is reported to have had a bounding and whirling motion, and to have swept everything from its path where it touched the ground. A loud, rumbling noise was heard from the cloud, which emitted brilliant lightning. A noteworthy fact is that the rainfall, while heavy during the passage of the storm, was not nearly so heavy near the track as it was at points 50 to 100 miles to the southward, where it was generally excessive. Heavy and damaging hail also fell at points to the south of the storm's path.

At Albertville, a 9-ton oil tank was picked up and carried about a half mile, and a train of 9 freight cars was overturned and the cars torn from their trucks and destroyed.

It is understood that the official in charge of the Birmingham office will render a detailed report on the damage done by this tornado at Dora and Bergens.[1] Reports from reliable sources show the loss of life and damage to property at the places named, to have been as follows:

Place.	Killed.	Injured.	Buildings destroyed.	Value.	Other damage.
Dora and Bergens	12	16	27	$25,000	$25,000
Warrior	5	11	15	6,000	10,000
Royal	1	6	10	8,000	25,000
Winnville	2	0	4	4,000	5,000
Albertville	15	150	150	250,000	100,000
Tenbroek	0	0	1	1,000	5,000
Sylvania	0	5	30	50,000	75,000
Totals	35	188	237	344,000	245,000

There was doubtless much other damage, and possibly some additional loss of life and personal injury of which no report has been received. It is conservatively estimated that the total damage to property by this tornado approximates $650,000.

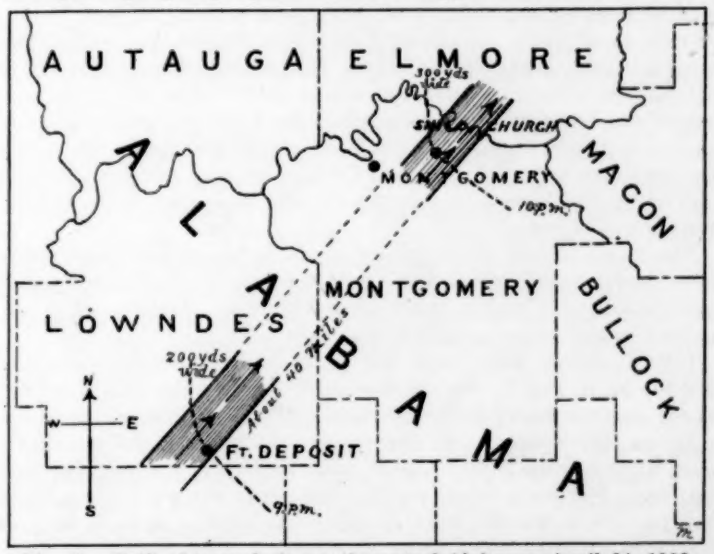

Fig. 2.—Path of tornado in south-central Alabama, April 24, 1908.

Another tornado swept over portions of Lowndes and Montgomery counties in south-central Alabama during the evening of April 24. This tornado made its appearance about 3 miles southwest of Fort Deposit, Lowndes County, at 9 p. m. and ended about 40 miles to the northeast, in the northern portion of Mongomery County, and about 8 miles northeast of the city of Montgomery, at about 10 p. m. The path (see fig. 2) was not continuous, and had an average width of 250 yards

[1]The report by Mr. Lehman appears elsewhere in this issue.—EDITOR.

where the storm struck the ground. On account of darkness, no funnel-shaped cloud was observed, tho a loud, roaring noise was heard as the storm past. At Fort Deposit 2 persons were killed, 22 were injured, 50 buildings valued at $50,000 were destroyed, and other damage done to the extent of $30,000. At Shiloh Church, a small settlement 7 miles northeast of Montgomery, 2 frame buildings were partially destroyed, and other damage done, aggregating about $3,000.

A tornado occurred at Tarentum, a small settlement in the southeastern part of Pike County, Ala., at 1:30 a. m., April 30, 1908. The track of this tornado extended about 3 miles in a northeasterly direction and was about 400 yards wide. No funnel-shaped cloud was observed tho the storm was accompanied by a rumbling noise which was immediately followed by a heavy downpour of rain and hail. No one was killed, but 10 people were injured, 25 frame buildings valued at $25,000 were destroyed, and other damage done to the extent of $10,000. The hail was quite heavy and caused considerable additional damage to crops.

TORNADO AT DORA AND BERGENS, ALA., APRIL 24, 1908.

By W. F. LEHMAN, Observer. Dated Birmingham, Ala., May 28, 1908.

The first of the tornadoes that occurred in northern Alabama on April 24, 1908, developed in southeastern Walker County during the early afternoon, and at about 2:40 p. m., central time, destroyed the settlement of Bergens on the Northern Alabama Railroad, 22 miles northwest of Birmingham. In its early stage the storm crost a sparsely settled district, advancing in a northeasterly direction and causing havoc over a track three-quarters of a mile wide. It was not until the storm was joined, about a mile southwest of Bergens, by another black mass of clouds, smaller in extent and moving in a more easterly direction, that it developed its greatest violence. Continuing on a northeast course the tornado ravaged a territory nearly a mile wide, but encountered few dwellings until it struck the hill ranges of Dora. Here the path of destruction narrowed down to about 3,000 feet.

Dora is a town of about 2,000 inhabitants and rather extended limits, partly situated in the valleys formed by three hill ranges running southeast–northwest. The business portion of the town is built alongside the railroad track between the central and northern hills, both about 150 feet high, while the southern valley is occupied by farmers and miners. Southeast of the hills, within earshot of the sheltered Dora habitations lies Bergens.

The claim of the Dora people that the hills saved their town from destruction induced the writer to spend a day and a half in exploring the storm track around Dora. The result is embodied in the accompanying diagram.

Fig. 1 shows that had the path of destruction remained as wide as it was to the southwest it would have embraced the whole eastern half of Dora, and also that it again widened out to its earlier width when the storm past beyond the northernmost of the Dora hills. As it was, however, the central path past over Bergens, while on the west side the path of destruction narrowed to one-half its original width so that only on the Dora hilltops were trees uprooted. The eastern side of the path of destruction continued uninterrupted a half mile wide.

On the forenoon of the 24th the weather had been cloudy and squally. A slight shower occurred shortly after noon. The uniform, light gray appearance of the sky an hour before the storm, set people to wondering what would happen next. Some predicted rain, but there was no sign of rain. The unusual weather conditions were the topic of conversation everywhere. Some one suggested a coming tornado, tho he had never experienced one, and for want of a better explanation of the prevailing conditions this idea was generally adopted. But the people were wofully ignorant as to the character of a tornado and the direction from which to expect it. Had they known, probably no lives would have been lost. From unobstructed viewpoints the meeting of the two clouds had been observed half a minute before the storm arrived, but most of the people of Bergens can only recollect seeing the cloud coming, rushing to their houses for shelter (there were no tornado cellars), and having their houses blown down; all this happening within the space of fifteen seconds.

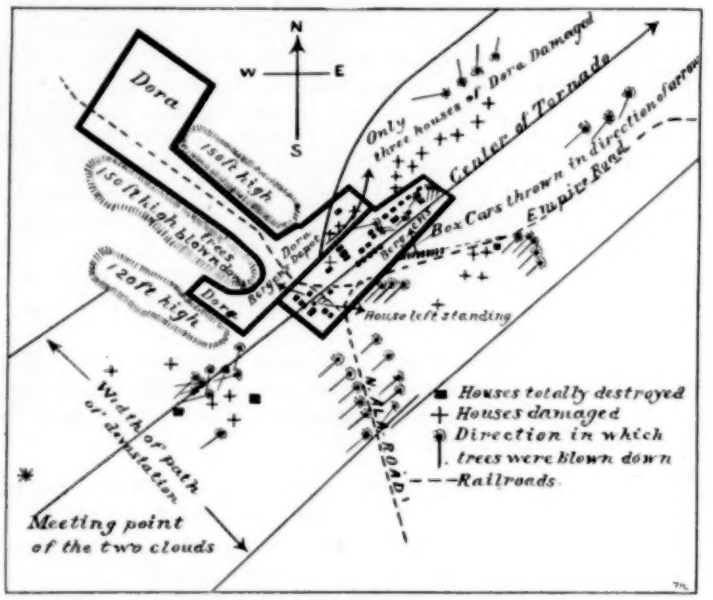

FIG. 1.—Path of storm thru Dora and Bergens, Ala.

The cloud is generally described as a dense coal-black mass with a whitish top, reaching to the ground. To some its central mass, between the top and the ground, seemed to revolve around a horizontal axis. Some observers noticed the cloud had a distinct funnel shape as it retreated into the distance. The tornado was attended by lightning and hail, some hailstones measuring three-quarters of an inch in diameter. The rain was light until some minutes after the cloud had past, when a heavy shower of short duration occurred. The roar caused by the storm was so deafening that no mere sound of crashing buildings could be heard.

Of the first group of ten houses, situated within 500 feet of the depot, eight were totally destroyed, including the depot, while one building almost in the center of the group escaped without any damage, and a substantially built two-room house was thrown bodily on the railroad track 75 feet away from its foundation. Farther on all the dwellings, the store, and the church of Bergens were razed to the ground. Of ten empty box cars standing on a side track of the Empire Road three were overturned and the other seven were blown toward the center of the storm track, some heavy parts being carried 100 feet away to a low hill. In the southeastern portion of the path all the tall trees were either blown down or snapt off at from 10 to 20 feet above the ground, and every house sustained heavy damage. At Bergens six persons were killed outright and two died of their injuries on the same day; the other injured number sixteen. Twenty-seven houses were totally destroyed and fifteen more or less damaged. The property destroyed was valued at about $50,000.

From Bergens the tornado progressed toward the northeast, with a path three-quarters of a mile wide. The few dwellings in its way were badly damaged, and at Old Democrat, a village 4 miles northeast of Dora, several houses were blown down and two persons were killed.

OBSERVATIONS OF A TORNADO NEAR FORT WORTH, TEX.

By D. S. LANDIS, Observer. Dated Fort Worth, Tex., June 3, 1908.

At 3:05 p. m. on May 29, 1908, a whitish, smoky-looking bank of clouds loomed up rapidly in the southwest, and within a few minutes similar banks of alto-cumulus clouds appeared in the west, then in the northwest. The fore front of each bank was flanked with whitish, curling, ragged-edged cloud substance, in appearance like billowy wood smoke from a distant forest fire. Within a period of five minutes cumulus clouds lying in the east and northeast began to move as tho sucked toward one common point on the Sansom ranch due north of the station, and about 4 miles distant. At this point a greenish-black cloud-core seemed to develop in the upper air, then bag downward, oscillate up and down in a careless rocking manner, drawing nearer and nearer to the earth, but failing to reach it by about 200 yards. This was the funnel of the tornado, the point of the funnel being ragged and misty looking, whirling and trailing inwardly upon itself. Presently the funnel bellied a little and at once became constricted to about half its original size immediately above the bellied portion. Next the whole cloud mass shot directly eastward for a distance of half a mile, stopt still, whirled rapidly for a few moments and then the funnel separated entirely at the stricture. The two portions of the funnel and the accompanying cloud mass now slowly backed, whirling gently, and again stopt, the tip now descending to the earth at the point where the funnel had formed. The upper portion then descended and the two parts of the funnel were reunited, the in-whirling motion becoming very energetic. Almost instantly after the union of the funnel portions the storm took on new electrical activity. Zigzag lightnings played in and out and about the funnel, which at times seemed like a great black transparent blood-vessel with the lightning a crimson fluid unleashed from the black walls to partially fall away, only to be grappled again by the darkness and hidden.

A thunderstorm prevailed during the passage of this peculiar cloud, and so continuous was the roar of thunder that one was at a loss to distinguish whether there were other sounds than its rolling.

At 3:08 p. m. the tornado center took on immense energy, and darted furiously toward the northeast, the funnel appearing very rigid and tapering down to a point within 200 yards of the earth. The funnel was ebony black, save when lit up by vivid sheet lightning on its east side. At one instant a spiral of lightning seemed to make two circuits of the funnel in its passage from the upper heights to the earth, the quiver of light leaping from the tip of the funnel to the earth. Within a space of two minutes more the dark funnel retired into the mother cloud overhead, and was lost from sight. Commotion in the clouds decreased rapidly, and they soon fell apart and so dissolved that only a few domes of cumulus clouds could be seen lying in the northeast, while the west and northwest sky was calm and cloudless. The whole affair seemed like a tornado on parade, sweeping the upper heights with threatening storm-tentacles of wind and mist and lightning, coming close down to earth as with death-dealing intent, only to repent and hide away from human eyes.

Among the weather features particularly noted were a very high relative humidity just before and after the storm, and a light wind from the south before the funnel formed. The wind direction changed very noticeably to various points as the storm past. At 3 p. m. the wind was prevailing from the south, and instantly it switched to the west, then to the northwest, north, and northeast in the course of the storm movement. The temperature during the whole storm period was 84°, but it fell quite decidedly for several hours after the passing of the clouds. Light rain prevailed at the station during the storm, also in the immediate vicinity of the tornado funnel, but no hail was reported. No marked wind movement was noted at the station with the passing of the storm, but those who were in the immediate vicinity of the funnel report a high wind from the east, with brisk wind movement from all points of the compass as the storm was passing. No damage to person or property was reported, the funnel coming to the earth for an instant only, and then in a wide pasture, treeless, fenceless, and houseless. The movement of the cloud for the few seconds that the funnel touched the earth was toward the northeast, herbage only showing the disturbance, grasses and weeds being inclined on the east quarter of the funnel as tho the wind were whirling from left to right. The herbage inclination on the north, northwest, and west showed the same right to left whirling motion of the wind. At the center of the path the grasses showed a pulled-together-at-the-top-influence, as tho suction had been inward and upward. The storm track visible on the ground was about 30 yards wide at the widest, and about 20 feet wide at the narrowest point. The earlier movement, directly eastward and then back to the starting point, was about half a mile each way, and the final northeastward movement of the cloud was about 4 miles to the point of dissolution. No glow was noted in the funnel or about it, nor any peculiar light, except the lightning, which varied from blood red to a blue flame like that of sulfur. No peculiar cloud form was noted, except that the clouds in the southwest and east elongated and dipt downward at the fore front, becoming torn and scud-like, whitish, and misty, seemingly rushing down an incline to a steep valley. With the union of all the clouds from the various points they changed color from the wood-smoke hue to a black cloud-core from which point the funnel lowered and the electrical display seemed to issue.

TORNADOES IN MINNESOTA ON MAY 24, 1908.

(Abstract from Climatological Report of the Minnesota Section.)

On the afternoon of May 24, 1908, two tornadoes visited southern Minnesota following on the warm, sultry weather of the preceding day. The first tornado appeared at 4:15 p. m., 3 miles southeast of Imogene, Martin County. It moved northwestward for about 2 miles along a path 40 rods in width, destroying $4,000 worth of property and injuring 4 persons.

The second storm formed at 4:30 p. m. in Blue Earth County, 25 miles northeast of Imogene, and traveled slightly east of north until it crost Lake Ballantyne when it disappeared about 4:50 p. m. The path of this tornado was 20 to 40 yards wide. One person was injured and property to the value of $5,000 destroyed. Detailed accounts of both tornadoes and a map showing the path of the second may be found on page 36 of the Climatological Report of the Minnesota Section for May, 1908, prepared by U. G. Purssell, Section Director.—EDITOR.

SEVERE LOCAL STORM IN FLORIDA.

Mr. C. L. Hobbs, cooperative observer of the Weather Bureau at Blountstown, Calhoun County, Fla., reports that a severe local storm occurred in the vicinity of his station about 1 o'clock in the afternoon of May 30, 1908. There was a well-defined pendant funnel-shaped cloud, with rotary winds of sufficient violence to uproot trees and prostrate buildings. The storm came from the northwest and moved toward the southeast.

Part of Mr. Hobbs's interesting description is given:

We had just finished dinner and heard a roaring noise and upon looking in a northwest direction we saw the tops of the trees swaying and bending in a terrible commotion. The greatest strength of the storm seemed to be some distance above the earth; however, the funnel dipt down right in the town, wrecked a new building 80 by 30 feet, then shot up to the tree tops and disappeared entirely. There were no trees prostrated in any general path; as before stated, the greatest violence

seemed to be up high, and its path thru the town was along a creek where there were generally no large trees. The damage to property amounted to about $1,700. No lives were lost and no one was injured.

Unsettled pressure conditions prevailed in the South on the morning of May 30, there being a storm of considerable energy off the Carolina coast and a shallow depression in Louisiana. Over western Florida the weather during the day was generally partly cloudy, with southwest to west winds. Practically no rain fell in that section, and the observer at Blountstown reported only a light sprinkle. Rain set in over the western counties during the night of the 30th, and the amounts measured on the following day in several instances exceeded an inch.—*T. F. D.*

A HURRICANE IN THE WEST INDIES IN MARCH, 1908.

By JOHN T. QUIN. Dated St. Croix, Danish West Indies, May 20, 1908.

In the first week of March, 1908, we of the islands in and around the northeastern corner of the Caribbean Sea were surprised to experience weather of so boisterous a character that it reminded us of what sometimes takes place in the regular hurricane season, weather whose behavior suggested the passage of a cyclone, but a cyclone following a quite unusual track.

Here, in St. Croix, there was a marked change in conditions on the 4th of the month, when the wind, as shown in Table 1, leaving the east-southeast direction, in which it had been blowing, went round to southwest. During the night it went thru west to west-northwest, from which point it was blowing hard early in the morning of the 5th. Later in the day it shifted to northwest, and during the following two days it blew a half-gale from north or thereabouts. On the afternoon of the 7th it was shifting toward northeast, to which point it had gone round before dawn on the 8th, during which day it shifted still farther till it arrived at east-southeast again. Hence it had gone thru all the points of the compass during the five days. This remarkable journey, along with the rather low barometer from the 3d of the month, appeared to show that a cyclone center was passing north of these islands from about west-northwest to east-southeast. But this seemed so unlikely that it was easier at first to suppose that there must have been some other cause for these changes. It was only on the night of the 7th, when the barometer began to fall and the wind continued to shift more to the east, and on the morning of the 8th, when the barometer fell still lower and the wind went still further round, that it began to appear certain that a cyclone had at all events been now developed and that it was entering the Caribbean Sea.

At St. Thomas the same wind changes were observed as at St. Croix, and the barometer at its lowest, which was at 3 a. m. on the 8th, stood nearly at the same height, namely, 29.80.

As information from the other neighboring islands began to come in after the storm had past, its character and movements became more and more clear, till it seemed plain that a cyclone of considerable force, originating to the northward, had moved first toward east-southeast and then southeast, then had curved to the southwest and entered the Caribbean Sea. By and by it became possible to say just where the cyclone center had past thru the Caribbean chain of islands, namely, between St. Christopher on the southeast and St. Eustatius on the northwest. This is manifest from the fact that at St. Christopher and at Nevis all the small craft lying, as is the case nearly everywhere in the Caribbean chain, on the westward or lee side of the islands were driven ashore, while at St. Eustatius the vessels (also on the lee side) were driven out to sea. A schooner navigated by the mate and a couple of hands arrived at St. Thomas and reported having been driven off from St. Eustatius by the storm, the captain and the rest of the crew having been left ashore, as there was no possibility of communicating. On the 23d of March a telegram was received here in St. Croix from Porto Rico announcing that "a Curaçao sloop named the *Sea Hawk* was picked up off Arroyo on Friday (the 20th), abandoned and stripped of mast and sails." Subsequently it turned out that the sloop had broken away from her anchorage at St. Eustatius during the storm, all hands being on shore at the time. On the other hand, the St. Christopher Advertiser of the 10th contained a list of about twenty-four sloops and boats that had been driven ashore in the early morning of the 8th and been either entirely destroyed or badly damaged. The storm was at its height there at 2 a. m., when the barometer at Basseterre, St. Kitts, stood at 29.28. At Antigua, farther away from the center to the eastward, it stood at 29.62 at the same hour. Here in St. Croix, as noted above, the lowest barometer was at 4 a. m., when it stood at 29.83 and at St. Thomas an hour earlier at 29.80. No particulars in this regard have reached us from the other islands.

TABLE 1.—*Weather notes, February 29 to March 11, 1908, at Christiansted, St. Croix, W. I.*

Date.	Barometer, reduced.*	Wind and weather.	Rainfall.	Sea.
1908.	*Inches.*		*Inches.*	
Feb. 29	30.05	Fine, with light showers; high clouds in early morning from W. by S.	0.33	
Mar. 1	30.00	Moderate breeze from ESE.; low clouds from ESE.; high clouds very abundant from W. by S.; fast.	.05	
2	29.96	Cloudy; low clouds from ESE.	.00	
3	29.94	Cloudy most of day; lightning in evening; low clouds from SE.	.00	
4	29.98	Fine; heavy shower between 1 and 2 in the morning; light breeze SW.	.12	Moderate swell on reef.†
5	29.95	6:30 a. m., cloudy; clear by 8 a. m.; strong wind from WNW.; later from NW.	.14	Sea rather heavy.
6	29.99	Strong N. wind all day; low clouds in blue sky.	.00	Rough sea.
7	29.94	Squally, with light showers; wind strong from N., increasing and shifting toward NE.	.12	Sea increasing; magnificent breakers on reef in afternoon.
8	‡29.83	Heavy weather all night, wind shifting thru NE. to ENE. by 8 a. m., to E. by 11 a. m., to SE. by E. by 4 p. m., still gusty, but greatly abated.	.19	Grand sea on reef in forenoon; greatly abated by 4 p. m.
8	30.04			
9	30.09	Cloudy in early morning, cleared by 8 a. m.; fine day; light breeze from E.	.27	Sea subsided.
10	30.10	Fine; moderate breeze from ENE.; light showers occasionally.	.12	Sea subsided.
11	30.11	Fine; fresh breeze from E. or E. by N.; occasional squalls, with light showers.	.12	Moderate swell on reef.

* At 10 p. m., except where otherwise stated.
† The reef referred to is the "Long Reef," at Christiansted. It faces northeast.
‡ At 4 a. m.

In regard to the rainfall from this disturbance, we learn from the reports of Mr. Shepherd, Agricultural Superintendent at St. Kitts, to the Imperial Department of Agriculture, Barbados, that in the north of St. Kitts the fall was 8 inches, at Basseterre, in the southeast of St. Kitts, it was 4 inches, and in Nevis, still farther to the southeast, it was 3 inches. This gradation is interesting as confirming the view that the cyclone center past thru the channel between St. Kitts and St. Eustatius. Here in St. Croix, at a distance of about 120 English miles from the center, the rainfall did not amount to 1 inch.

Before reaching the above-named channel the center had past near to St. Bartholomew, where some damage was done to buildings, among others to the Anglican Church. In St. Martins, lying northwest of St. Bartholomew, considerable damage was done to the tents of the peasants and to the cotton crop. The news from that island is also interesting as containing the information that the wind went round thru east, as in the Danish Islands, showing that St. Martins was on the same side (the northwest side) of the storm.

Of the cyclonic nature of the storm there can be no doubt; but whether it had the usual calm center or not there is no evidence to show.

In regard to the track of the storm center shortly before it came among the West Indian Islands we have two clues. The

Leyland Line steamer *Barbadian* reached St. Thomas from Liverpool on the morning of Saturday the 7th and reported having encountered a southwest gale on Thursday the 5th, changing to a northwest gale on Friday the 6th. In the absence of more precise information we can only deduce from this that the storm center was north of the ship's position at some time in the course of Thursday night, when she would be between 200 and 300 miles from St. Thomas. Again, the three-masted schooner, *Hattie C. Luce*, which arrived at St. Thomas with a cargo of ice on the 10th, reported having met with a hurricane in the neighborhood of Sombrero, with the consequent loss of some of her sails.

It has not been possible to find much information bearing on the earlier course of the cyclone, that is to say its track before it moved, or while it was moving, say from west-northwest to east-southeast; it may, however, be noted that the S. S. *Parima*, of the Quebec Line, arriving at St. Thomas on the morning of the 7th, reported bad weather "all the way out," and that the S. S. *Praesident*, of the Hamburg-American Line, which left St. Thomas for San Juan, Santo Domingo City, etc., on the 3d of the month, fell in with a gale as she was passing thru the Mona Passage on the night of the 4th; but we have no details from either of those vessels.

From the above it would seem that the cyclone in question followed a track opposite in every particular to the track usually followed by cyclones originating within the Tropics in the hurricane season. For its curve, instead of being convex toward the west, was convex toward the east, and was made by a movement southward instead of northward; its track before making the curve was apparently from about west-northwest to east-southeast, instead of being from east-southeast to west-northwest; and its track after passing the curve was from northeast to southwest, instead of being from southwest to northeast. It seems that the storm must have died out in the eastern part of the Caribbean, for nothing has been heard of it from any of the large islands to leeward.

The movements of the high clouds, as seen from St. Croix, failed to throw any light on the movements of the vortex of the storm. High clouds were seen here on the 28th of February, moving from west by north, and again on the 29th and on March 1, on both of which days they were moving from west by south. After the 1st no high clouds were seen, altho there was a good deal of blue sky the whole time, and the writer frequently lookt for them. There is presumably a good deal to be learned about the movements of the higher air during the passage of a cyclone, and even a negative result, as in the present case, may have some value among the observations necessary to throw light on this interesting branch of inquiry.

TORNADO AT PEKIN, ILL., MARCH 27, 1908.

By DEWEY A. SEELEY. Dated Peoria, Ill., April 6, 1908.

A severe local storm occurred at Pekin, Ill., March 27, 1908. A lengthy newspaper account may be found in the Peoria Journal of March 28.

I visited the scene of this destruction a few days after the storm occurred and am of the opinion that the storm was tornadic in character, altho of small proportions.

The storm traveled in a northeasterly direction, starting in the southwestern portion of the city at the outskirts, thereby traversing the southeastern section.

The débris was scattered in all directions, but was mostly carried northeastward along the storm's path. The storm occurred about 8:30 p. m. As far as I could learn no one observed a funnel-shaped cloud or other extraordinary phenomena. The rain accompanying the storm was reported to be very heavy. No hail was reported to have fallen. Several witnesses spoke of the unusual and peculiar attendant noises. There were several indications of the presence of a whirl, the débris being distributed in all directions. A whirling motion was also indicated by the fact that several barns and outbuildings were lifted from their foundations and dropt some distance away, bottom side up. The roof of one store building was carried away and the front windowpanes of the store blown outward.

The trees and other débris lay in an easterly direction in the center line of greatest destruction. On the right side the direction was mostly easterly, and on the left, more to the north. The path, as far as it was traced, was probably about one and one-half miles in length, and the width at the point of greatest destruction did not exceed 150 feet. The storm seemed to jump, from time to time, over distances varying from one to three blocks, leaving the property in these places unmolested, then to proceed with its destructive effect for one or two hundred feet. No persons were killed by the storm.

WINDSTORM AT PEORIA, ILL., MAY 5, 1908.

By DEWEY A. SEELEY, Observer. Dated Peoria, Ill., May 7, 1908.

A windstorm occurred in this city about 3 a. m., May 5, 1908. An account is published in the Peoria Star of that day.

I am of the opinion that the storm was somewhat tornadic in character. However, the devastation in but one locality points to this conclusion. I have searched in all directions for evidences of destruction resulting from circular wind movement without finding any other.

The wind was high easterly during the early morning. It swept across Peoria Lake, which lies along the northeastern border of the city. This is simply a widening of the Illinois River, probably a half-mile across. The waves were reported to be six or eight feet high on the west side of this lake, and considerable damage resulted to small boat houses and craft along the shore.

The store buildings which were damaged were 1,000 feet away from the shore, on a bluff probably 50 feet high, and were four to eight-story buildings.

May it not be possible that the circular motion evidenced by the wind when it reached these buildings was due to an eddy caused by the wind rushing between the buildings?

A window on the southwest side of the Schipper and Block Building was blown outward, every particle of glass falling outside of the building. A tile was lifted from the edge of the roof, raised several feet in the air, and dasht into a cupola. The gravel over a small section of the roof near the point from which the tile was taken was entirely cleaned away, while a few feet distant an unprotected lumber pile containing small pieces of timber, was unmolested. Across the street another small window was demolished, the glass in this case also all falling outside the building. It was carried toward the northeast, that is, in just the opposite direction from the glass on the former building.

The barograph trace at the Weather Bureau station, which is located about one and one-half miles northwest of the damaged stores, exhibited a sudden fall in pressure of about 0.17 of an inch, and an equally abrupt rise at the time the damage was done. The wind direction pens recorded every direction during the time, changing rapidly from one point to another. No thunder and lightning accompanied the disturbance, and no rain fell at the time. The highest wind velocity for a five-minute period recorded at the station was 36 miles an hour, and no single mile was registered at a much higher rate.

ICE CONDITIONS ON THE GREAT LAKES, WINTER OF 1907-8.[1]

By NORMAN B. CONGER, Inspector and Marine Agent. Dated Detroit, Mich., May 16, 1908.

The amount of ice on the Great Lakes during the winter of

[1] Similar details as to ice in the Great Lakes will be found for the winters of 1899–1907 in the Lake Charts for those years, as compiled by Mr. N. B. Conger and Prof. A. J. Henry and published semiannually by the Weather Bureau.

1907–8 was about the same as for the previous winter. It was not as heavy, but the fields in Lakes Superior, Huron, and Erie were more extensive. In Michigan the conditions were normal, except that the ice in Green Bay remained intact longer than the year preceding. Over the western portion of Lake Superior the fields were not very extensive at any time. Over the eastern portion, during the month of March, the fields were at times quite extensive, extending from Keweenaw Point eastward to Whitefish Point. These fields were moving with the winds and were not at any time reported as being heavy. In Whitefish Bay the ice was not as heavy as usual.

In Lake Michigan the ice fields were confined mostly to the northern portion, altho ice was reported over the southern portion for about ninety days during the entire winter. From Traverse Bay northward the field was solid and did not break up until the latter part of April, when brisk westerly winds broke up the ice and moved a portion of it thru the Straits of Mackinaw into Lake Huron.

At the Straits the ice was not heavy and did not windrow until the breaking up began in April. Westerly winds moved the ice fields in from Lake Michigan, windrowing the ice in the straits and forcing some of it into Lake Huron.

In Lake Huron the ice fields over the northern portion were moving with the wind during the winter, and did not reach any great thickness. The field movement indicates that the ice did not extend far out into the lake. At the southern end the ice field formed but one bridge (at Port Huron), and when that one broke on March 16, 1908, it was not again formed and the ice fields practically disappeared from the southern portion.

There was very little trouble with the ice in the rivers. At Detroit the ice impeded navigation from about January 29 to February 10, 1908.

In Lake Erie there appeared to be more ice than during the preceding year, but the fields over the western portion moved out from shore and down to the east end, so that on the average the period of ice fields was shorter than last year. The packing of the ice fields at the east end is a yearly feature on this lake on account of the prevailing southwesterly winds. The ice did not disappear at the east end until May 9, 1908.

In Lake Ontario there was less ice than has been reported in previous years. The fields were small and did not remain long.

Comparing the period during which ice was reported in the several harbors with the same period last year, the ice did not remain as long. The average for all the lakes this year was 98 days and for 1906–7 was 104 days. The record by lakes is shown in Table 1; while the dates of opening and closing of navigation at the principal ports are stated in Table 2.

TABLE 1.—*Duration of ice in harbors on the Great Lakes (averages by lakes).*

Lake.	1906–7.	1907–8.
	Days.	*Days.*
Superior	129	121
Michigan	89	90
Huron	103	108
Erie	93	91
Ontario	103	82

TABLE 2.—*Dates of opening and closing of navigation on the Great Lakes, season of 1907–8.*

Stations.	Closed.	Opened.	Remarks.
Lake Superior.			
Duluth	Dec 12,1907	Apr. 8,1908	
Whitefish Point		Apr. 25, 1908	
Sault Sainte Marie	Dec. 10, 1907	Apr. 24, 1908	
St. Mary River	Jan. 27, 1908	Mar. 26, 1908	
Lake Michigan.			
Escanaba	Dec. 11, 1907	Apr. 19, 1908	
Kewaunee			Open all winter.
Michigan City	Feb. 1, 1908	Mar. 10, 1908	
Manitowoc			Open all winter.
Milwaukee			Closed on two days only.
Racine			Open all winter.
Macatawa		Mar. 17, 1908	
Grand Haven			Open all winter.
Manistee			Open all winter.
Mackinaw	Dec. 18, 1907	Apr. 19, 1908	
Lake Huron.			
Oscoda	Jan. 18, 1908	Mar. 19, 1908	
St. Clair River.			
Port Huron	Jan. 24, 1908	Mar. 16, 1908	
Detroit River.			
Detroit	Dec. 18, 1907	Apr. 1, 1908	The Detroit and Cleveland line stopt on December 7, 1907, but steamer *Mary Boyce* past down on the 18th.
Lake Erie.			
Sandusky	Dec. 15, 1907	Mar. 9, 1908	
Conneaut		Mar. 17, 1908	
Erie	Jan. 21, 1908	Mar. 14, 1908	
Buffalo	Dec. 22, 1907	Apr. 25, 1908	
Lake Ontario.			
Charlotte		Feb. 3, 1908	
Oswego		Apr. 9, 1908	
Welland Canal		Apr. 14, 1908	

TABLE 3.—*The ice conditions on the Great Lakes during the winter of 1907–8.*

LAKE SUPERIOR.

Stations.	Ice first formed.	Maximum thickness.		Ice disappeared.	Remarks.
		Inches.	Date.		
Duluth, Minn	Nov. 22, 1907	24.0	Jan. 20, 1908	Apr. 15, 1908	The harbor was partially or wholly covered with ice about the usual length of time, but the average thickness was from 5 to 7 inches less than the 10-year mean. In the lake there was more or less ice visible from January 29 to April 5, but the area and thickness were both below the 10-year average.
Rayfield, Wis	Jan. 3, 1908	21.0	Mar. 25, 1908	Apr. 18, 1908	
Washburn, Wis	Dec. 20, 1907	27.0	Feb. 15, 1908	Apr. 15, 1908	
Ashland, Wis	Dec. 7, 1907	28.0	Mar. 5, 1908	Apr. 18, 1908	A very mild winter. There was but little snow until after the latter part of February, and no heavy snowfalls.
Ship Canal, Mich	Nov. 27, 1907	14.0	Feb. 27, 1908	Apr. 18, 1908	The ice has entirely disappeared (April 20, 1908) from the lake in the vicinity of this station.
Houghton, Mich	Nov. 30, 1907	21.0	Mar. 10, 1908		The ice disappeared in the upper entry about April 20, and from Big Portage about April 25 or 26, 1908. There was less than the usual amount of ice.
Eagle Harbor, Mich	Jan. 2, 1908	18.0	Mar. 5, 1908	Apr. 13, 1908	The ice in the lake was broken and moving with the wind thruout the winter.
Marquette, Mich	Jan. 27, 1908	8.0	Mar. 21, 1908	Apr. 5, 1908	The ice did not begin to form until the last week in January. From then till February 22 it would scarcely attain a thickness of 1 or 2 inches when the wind would break it up and cause it to drift out.
Munising, Mich	Jan. 10, 1908	20.0	Mar. 30, 1908	Apr. 23, 1908	All floating ice in bay and lake disappeared on the night of April 23.
Grand Marais, Mich	Dec. 3, 1907	30.0	Mar. 15, 1908	Apr. 28, 1908	The ice fields were not as extensive as in former years, and but little ice appeared in the lake until about March 1. Some few banks remain along the shore (April 28) tho the bay and lake are clear of ice.
Whitefish Point, Mich	Feb. 1, 1908	20.0	Mar. 20, 1908	May 1, 1908	The ice had practically disappeared on May 1, tho there still remained some small floes and a few banks along shore. Field ice made its appearance off this point on February 16, and moved with every shift of the wind till it disappeared. The fields were as extensive, but not as heavy as one year ago. The first boat past thru the ice with ease April 25.
Sault Sainte Marie, Mich	Nov. 29, 1907	17.0	Feb. 24, 1908	May 1, 1908	The ice has practically disappeared tho small quantities of floating ice were observed on May 1. Hay Lake was frozen so that people were crossing on the ice on January 5.

TABLE 3.—*The ice conditions on the Great Lakes during the winter of 1907–8*—Continued.

LAKE MICHIGAN.

Stations.	Ice first formed.	Maximum thickness.		Ice disappeared.	Remarks.
		Inches.	Date.		
Gladstone, Mich	Nov. 14, 1907	23.0	Mar. 30, 1908	Apr. 19, 1908	Upper bay still (April 20) partially covered by floating ice; lower bay clear.
Escanaba, Mich	Dec. 30, 1907	23.0	Mar. 16, 1908	Apr. 19, 1908	Little Bay de Noquette not permanently frozen over until January 13. The ice in the lower portion of the bay went out April 15.
Menominee, Mich	Dec. 5, 1907	18.0	Mar. 3, 1908	Apr. 14, 1908	Floating ice fields became solid about January 28, and broke up April 10.
Green Bay, Wis	Dec. 2, 1907	13.0	Feb. 13, 1908	Mar. 13, 1908	The ice disappeared in this end of the bay on April 11, 1908.
Sturgeon Bay, Wis	Dec. 11, 1907	22.0	Feb. 25, 1908	Apr. 14, 1908	The canal froze over once tho at no time during the winter was there sufficient ice to prevent boats from entering the canal from the lake.
Kewaunee, Wis	Dec. 15, 1907	3.0	.....	Mar. 15, 1908	Navigation open all winter.
Manitowoc, Wis	Nov. 29, 1907	18.0	Jan. 20, 1908	Mar. 10, 1908	The ice fields did not materially interfere with the ferries at this port during the past winter.
Sheboygan, Wis	Dec. 18, 1907	18.0	Feb. 1, 1908	Mar. 20, 1908	No ice fields were observed off this port during the past winter.
Milwaukee, Wis	Dec. 12, 1907	.....	Mar. 1, 1908	Mar. 6, 1908	The first ice on the slips near the mouth of the river formed on January 9, and reached a maximum thickness of 5 inches February 4 and 5. This ice disappeared March 17, 1908. There was considerable slush ice in the bay and river from the last part of January till the first part of March and at times it extended to a depth of from 6 to 12 feet. Navigation was interrupted on only two days, February 5 and March 1, when strong easterly winds packed the ice in the bay. Clear water was in sight all winter.
Racine, Wis	Jan. 17, 1908	.....	.....	Mar. 23, 1908	The harbor at this port was clear of ice all winter. Dates given refer to first and last ice observed in the lake off this port.
Kenosha, Wis	.....	.....	.....	.....	No report received.
Chicago, Ill	Jan. 9, 1908	5.0	Jan. 31, 1908	Mar. 8, 1908	There was much less ice during the past winter than usual. During the last week of January the ice was solid for some distance out, at other times there were only floating fields.
Michigan City, Ind	Dec. 1, 1907	15.0	Feb. 20, 1908	Apr. 1, 1908	The ice which formed on December 1 soon melted and the harbor remained open until February. There was not as much ice in the lake as usual.
St. Joseph, Mich	Jan. 10, 1908	10.0	Feb. 15, 1908	Mar. 1, 1908	
South Haven, Mich	Jan. 13, 1908	8.0	Jan. 24, 1908	Mar. 24, 1908	There was but a small amount of field ice this winter. Open water was visible at all times.
Saugatuck, Mich	Dec. 21, 1907	12.0	Jan. 31, 1908	Apr. 12, 1908	
Holland, Mich	Dec. 2, 1907	6.0	Jan. 2, 1908	Mar. 18, 1908	
Macatawa, Mich	Feb. 1, 1908	10.0	Feb. 18, 1908	Mar. 18, 1908	There has been very little ice in Lake Michigan off this port during the past winter.
Grand Haven, Mich	Jan. 23, 1908	2.0	Feb. 10, 1908	Mar. 16, 1908	There has been somewhat less ice here than in previous years and it has caused but little trouble to navigation. Interruptions of a few hours duration on January 25, February 2 and 6, were due to the ice fields being driven in by westerly winds and choking the harbor entrance.
Muskegon, Mich	Dec. 15, 1907	14.0	Feb. 1, 1908	Apr. 1, 1908	The ice fields extended out 500 feet and along the north and south shore as far as the eye could reach.
Ludington, Mich	Dec. 3, 1907	15.0	Feb. 24, 1908	Mar. 28, 1908	There was very little ice in Lake Michigan visible from this station and no large fields were observed during the past winter.
Manistee, Mich	Dec. 9, 1907	18.0	Mar. 1, 1908	Mar. 30, 1908	There was less floating ice and the shore ice did not extend out as far as usual. Passenger steamers have entered this harbor every week during the past winter without material difficulty from ice.
Glenhaven, Mich	Feb. 20, 1908	5.0	Mar. 5, 1908	Mar. 7, 1908	
Frankfort, Mich	.....	.....	Jan. 14, 1908	Mar. 20, 1908	No heavy ice was visible in Lake Michigan off this port during the past winter.
South Manitou, Mich	Feb. 28, 1908	4.0	Mar. 7, 1908	Mar. 21, 1908	Fresh southerly winds drove the floating ice northward on March 21, and it did not appear again.
North Manitou, Mich	Feb. 15, 1908	7.0	Mar. 7, 1908	Mar. 20, 1908	The ice moved off shore on March 10.
Charlevoix, Mich	Feb. 8, 1908	14.0	Mar. 1, 1908	Apr. 20, 1908	
Harbor Springs, Mich	Jan. 26, 1908	14.0	Feb. 20, 1908	Apr. 24, 1908	
Beaver Island, Mich	Jan. 21, 1908	20.0	Mar. 17, 1908	Apr. 20, 1908	The ice was mostly smooth and clear; no pack ice observed.
Mackinaw, Mich	Dec. 24, 1907	18.0	Jan. 30, 1908	May 7, 1908	The maximum thickness of 18 inches represents the greatest thickness to which ice formed. The last ice in the straits was heavily windrowed fields which were driven in from Lake Michigan by the wind, and they past on into Lake Huron.

LAKE HURON.

Mackinac Island, Mich	Jan. 15, 1908	24.0	Mar. 3, 1908	Apr. 25, 1908	The average thickness of the ice in the straits was but 12 inches. The first crossing to the mainland on the ice was on February 3, 1908.
Detour, Mich	Dec. 25, 1907	20.0	Feb. —, 1908	Apr. 28, 1908	The river and the lake off this station were practically free of ice on April 28, tho among the islands to the east of the station there was considerable floating ice which the wind had driven out of Georgian Bay.
Cheboygan, Mich	Jan. —, 1908	22.0	Feb. —, 1908	May 1, 1908	The ice broke up and this end of the straits cleared on April 18, 1908.
Presque Isle Light, Mich	Dec. 5, 1907	20.0	Feb. 25, 1908	Apr. 20, 1908	During the month of February and the earlier part of March the ice fields were large and extended beyond vision, tho some open water could be seen at times.
Middle Island, Mich	Nov. 15, 1907	8.0	Mar. —, 1908	Apr. 15, 1908	The ice was on the move all winter, hence did not form to as great a thickness as usual. It did not appear in any quantity until about January 15.
Thunder Bay Island, Mich	Jan. 1, 1908	12.0	Mar. —, 1908	Apr. 5, 1908	The ice was kept on the move and broken up by heavy east and northeast gales all the past winter. The snow was deep and some of it remained on the ground on April 25.
Alpena, Mich	Dec. 20, 1907	9.0	Mar. 10, 1908	Mar. 17, 1908	High northwest winds prevented the formation of solid ice in the bay during the early winter. The ice became solid February 16 and continued intact until March 15.
Oscoda, Mich	Dec. 10, 1907	12.0	Jan. 25, 1908	Mar. 13, 1908	Open water has been visible off this port all winter.
Ottawa Point, Mich	Dec. 2, 1907	16.0	Mar. 1, 1908	Mar. 27, 1908	There was but little field ice off this port during the past winter.
Bay City, Mich	Dec. 7, 1907	20.0	Jan. —, 1908	Apr. 12, 1908	
Pointe aux Barques, Mich	Dec. 10, 1907	24.0	Feb. 29, 1908	Mar. 25, 1908	The field ice was about the same in extent as in former years.
Harbor Beach, Mich	.....	18.0	Mar. 20, 1908	Mar. 31, 1908	There was no great amount of ice in the lake off this port during the past winter.
Lake View Beach, Mich	Feb. 1, 1908	12.0	Mar. 20, 1908	Mar. 26, 1908	
Port Huron, Mich	Dec. 8, 1907	20.0	Feb. 10, 1908	Mar. 16, 1908	The first ice from the lake ran into St. Clair River on January 23, and on the following day it was solid from Miller's coal dock, southward. On January 28 the river was jammed with ice from Lake Huron to Lake St. Clair, and the first ice bridge formed at the foot of the lake. On February 13 the ice dropt as far south as the head of Stag Island, and the river at this point was practically free from ice during the remainder of the season. On March 16 southerly winds caused the ice field at the foot of the lake to move northward, and the lower end of the lake was practically free from ice after that date.

DETROIT RIVER.

Detroit, Mich	Dec. 13, 1907	14.0	Feb. 10, 1908	Mar. 28, 1908	Local navigation was seriously impeded by ice from January 29 to about February 10.

LAKE ERIE.

Toledo, Ohio	Dec. 5, 1907	9.5	Feb. 7, 1908	Mar. 9, 1908	Ice that remained more than one day did not form until January 9, 1908. Maumee Bay froze over about January 16, 1908. The maximum thickness of ice on Maumee Bay was probably 12 to 13 inches on February 7 to 10.
Put-in-Bay, Ohio	Dec. 24, 1907	16.0	Feb. 10, 1908	Mar. 26, 1908	Teams did not cross to the main shore this winter. The heaviest ice was to the westward and northward of the island.
Kelleys Island, Ohio	Jan. 10, 1908	16.0	Feb. 10, 1908	Mar. 10, 1908	The south channel was not frozen over during the winter.
Marblehead, Ohio	Dec. 20, 1907	10.0	Feb. 19, 1908	Mar. 27, 1908	The ice off this point was not stationary at any time during the winter.
Sandusky, Ohio	Dec. 3, 1907	13.0	Feb. 10, 1908	Mar. 13, 1908	The ice was solid over the entire bay from January 8 to March 6, when heavy rains and prevailing strong southwest winds caused it to soften and break up. The lake was practically clear of ice after March 9.
Huron, Ohio	.....	.....	.....	Mar. 9, 1908	
Lorain, Ohio	Jan. 14, 1908	14.0	Jan. 27, 1908	Mar. 13, 1908	From January 24 to February 26 ice covered the lake off this port. The ice began to move away on March 6.

TABLE 3.—*The ice conditions on the Great Lakes during the winter of 1907–8*—Continued.

LAKE ERIE—*Continued.*

Stations.	Ice first formed.	Maximum thickness.		Ice disappeared.	Remarks.
		Inches.	Date.		
Cleveland, Ohio	Jan. 14, 1908	9.0	Feb. 20, 1908	Mar. 15, 1908	The lake was covered with ice in all directions from February 8 to 25. The closed season was one of the shortest during the last ten years; in both lake and harbor the thickness of ice fell much below the average for that period. The date of formation of ice in the harbor was the latest in the last ten years.
Fairport, Ohio	Dec. 11, 1907	14.0	Feb. 20, 1908	Mar. 7, 1908	
Ashtabula, Ohio	Jan. 15, 1908	11.0	Feb. —, 1908	Mar. 30, 1908	
Conneaut, Ohio	Dec. 2, 1907	14.0	Feb. 10, 1908	Apr. 1, 1908	Ice fields first appeared in the lake off this port January 9, 1908. There was more ice in the lake this year than last.
Erie, Pa	Dec. 18, 1907	12.5	Feb. 10, 1908	Apr. —, 1908	The harbor was partially frozen over from December 18 to 30, and again during the second week in January. Ice covered the lake as far as the eye could reach from February 3 to 26, after which it was broken up and drifted with the wind until early in April.
Dunkirk, N. Y	Jan. 12, 1908	9.0	Feb. 10, 1908	Apr. 17, 1908	
Buffalo, N. Y	Dec. 20, 1907	13.5	Feb. 10, 1908	May 9, 1908	The entire harbor was not frozen over till January 24, when most of this end of the lake was covered with thin floating ice for the first time. Solid ice first extended up the lake beyond vision on January 31, and it did not begin to break up till March 28. This end of the lake was practically covered with heavy ice fields from that date till May 1, after which the ice rapidly disappeared from the lake. The harbor was free of ice after March 23.
LAKE ONTARIO.					
Fort Niagara, N. Y	Jan. 24, 1908	12.0	Feb. 4, 1908	Apr. 10, 1908	
Charlotte, N. Y	Jan. 29, 1908	2.0	Feb. 3, 1908	Mar. —, 1908	But one small field of ice in the lake was observed after February 3, 1908.
Sodus Point, N. Y	Jan. 8, 1908	18.0	Feb. 20, 1908	Mar. 28, 1908	Only a few small ice fields observed in the lake off this port during the past winter.
North Fair Haven, N. Y	Jan. 4, 1908	16.0	Feb. 5, 1908	Mar. 28, 1908	There was very little ice in the lake at any time during the past winter, much less than usual.
Oswego, N. Y	Dec. 16, 1907	12.0	Mar. 2, 1908	Mar. 15, 1908	There was much less field ice during the past winter than usual, but considerable ice formed on the shore.
Sacketts Harbor, N. Y	Jan. 9, 1908	16.0	Mar. 10, 1908	Apr. 2, 1908	
Cape Vincent, N. Y	Jan. 15, 1908	15.0	Mar. 15, 1908	Apr. 10, 1908	
Ogdensburg, N. Y	Dec. 28, 1907	18.0	Feb. 15, 1908	Apr. 7, 1908	The ice was very slow to form in the river this winter. A heavy fall of snow prevented its freezing to any considerable thickness until in February.

EARLY METEOROLOGY AT HARVARD COLLEGE.

By R. M. VARNEY, Assistant in Meteorology. Dated Cambridge, Mass., June 6, 1908.

In the course of some work among the stacks and manuscripts of the Harvard College Library, the writer recently happened upon material relating to the early connection of Harvard with meteorology. The various writings which concern the early stages of this science in America seem worth presenting in outline, for their interest to present-day meteorologists.

The first definite mention of the subject, as directly concerning Harvard College, is to be found in a printed announcement of lectures by Isaac Greenwood, the first Hollis Professor of Mathematics and Natural Philosophy. His term of service extended from 1727[1] to 1738, inclusive. The lectures seem not to have been regularly presented to his classes, but were apparently delivered in public, under conditions which will be mentioned presently. They were accompanied by "a great variety of curious experiments," and numbered twelve in all. They were divided into three "articles." The last was entitled "Of the True Causes of the Principal Phænomena in Nature, by Means of the Newtonian Laws of Matter and Motion." The subjects of this third article occupied the last three lectures. First came "A View of the World Around Us Subject to these Laws;" then "An Enumeration of the Phænomena of the Solar System," with the inevitable "curious experiments;" then "Gravity * * * Fluids, Hydrostatical and Pneumatical;" and lastly, "Of the Action of the Sun and Moon Upon the Atmosphere and bodies contained therein * * * where with many other curiosities a particular consideration will be taken of Dr. Desagulier's late Theory of the Rise of Vapors and formation of clouds and Meteors, with his experiments concerning them."

The word *curiosity* is a good comment on the mental attitude toward science of the public of the early seventeen hundreds, and of the early nineteen hundreds as well. Greenwood's little syllabus is arranged in a fashion well calculated to appeal to prospective audiences, for it states not only that "the apparatus is compleat for the experiments," but that it "will be enlarged with new machines and models of some curious engines, lately invented, if there be a full course." At the end, however, comes this announcement: "Every subscriber to pay four pounds, one at the time of subscription, and the remainder on the third and sixth days of the course."

What lectures on meteorology Professor Greenwood gave before his regular classes does not appear; they probably embodied some or all of the "curious experiments," and probably occupied a very minor part of the whole course. This is quite to be expected; meteorology as such was almost unthought of in America at the time, and was everywhere treated as a small part of the general course on natural philosophy.

Greenwood's official successor was John Winthrop, who held his position from 1738 to 1779. During this long period of service he gave a series of lectures which must have attracted many students. The record of these is contained in a little leather-bound, closely-written note book, entitled "Summary of a Course of Experimental and Philosophical Lectures." The course hardly occupied the time of what is now called at Harvard a half-course, for it extended only from March 10 (the first year being 1746) to June 16. Winthrop's treatment of meteorology was considerably more elaborate than that of his predecessor; it included the atmosphere, the thermometer, and the barometer and its uses even to the measurement of altitudes. It is interesting to note the careful correlation he made between weather changes and the variations in the height of the mercury-column, the prevalence of high pressures when the wind is northerly, and the greater variation of pressures in winter. He gave a maximum variation for this country of two inches, from 28.75 to 30.75 inches.

Near the close of the twenty-fifth lecture, he writes thus: "Thermometers are of different kinds; as of air which forces water up into a tube by its elasticity, but it will never answer the (purpose?) because it's a barometer and thermometer too. They have till lately been made of spirits of wine; but those made of mercury are esteemed the best because they are most easily affected." Winthrop kept a personal meteorological record for about twenty years, beginning with 1742. The thermometer was "of Mr. Hawksbee's make", filled with spirits of wine. Its scale, an astonishing contrivance, began above at 0°, had its freezing point below at 65° and extended down

[1] This was the year of the death of Sir Isaac Newton.—*C. A.*

to 100° just above the bulb.[2] This arrangement caused Professor Winthrop some thought, for he wrote in his manuscript, "How it was adjusted in London I know not, but it appears to me yt ye freezing point is marked considerably too high, for having plunged ye bulb into a vessel of snow, I found ye spirits fell down to 76.5° and then rested." The Hawksbee scale proving a source of annoyance, the observations from 1759 to 1763 were taken on a Fahrenheit thermometer, with comparative readings from the other. Both thermometers were on the north side of his house—an attempt to insure the uniformity of exposure now attained by the shelter.

It is a noticeable fact that down to the close of John Winthrop's activity, meteorology at Harvard had been purely a matter of tabulation of observed temperatures and observed rainfalls, with little deduction or speculation therefrom. In his lectures, to be sure, Winthrop generalizes somewhat on the evident relation of pressure to weather; but speculative matter there is none.

In 1780 Samuel Williams became the Hollis Professor of Mathematics and Natural Philosophy. In that year began the development of a new "scientific spirit" at Harvard. There is preserved abundant manuscript evidence of Professor Williams's broad and broadening activity. "Lectures on Air," "Lecture on Magnetism," "The Motion and Phenomena of Heat as it Respects the Earth," and, most interesting of all from our meteorological side, "Change of Climate in North America," "Change of Climate in Europe," and "Causes of Changes in Climate"—these titles tell their own story. Mr. Williams was a member of the Meteorological Society of the Palatinate [Germany], of the Philosophical Society in Philadelphia, and of the Academy of Arts and Sciences in Massachusetts. In his manuscripts, from which these notes are taken, he informs us that "it was the author's duty to adapt them" (the lectures) "to the use of students in philosophy and astronomy." The lectures covered many other than meteorological and kindred subjects. Comets, the aurora borealis, and earthquakes occupied a prominent place. Seven whole lectures treated of the return, heat, atmospheres, tails, and effects of comets; one lecture treated of the aurora, the New England earthquakes occupied two, and one treated of the great darkness of May 19, 1780.

Among the manuscripts are preserved many which show the personal side of Professor Williams's activities. They include all sorts of observations of temperature and weather. A little hand-ruled, cardboard-covered pamphlet with "Meteorological Observations for 1790 and 1791" written on the cover, gives a very full thrice daily record for temperature, wind direction, and state of the sky, with a "remarks" column. The wind direction is given as, for instance, "N. W. 2." What the 2 stands for is uncertain, tho it would seem that it was one member of some scale of velocities.[3] The state of the sky is ingeniously shown by three signs: ⊙, ○—, ==, for clear, partly cloudy, and overcast, respectively. Comparative temperatures of various kinds seem to have interested Williams fully as much as weather observations properly so-called. From June 22, 1785, to September 26, 1786, he took observations of the "heat of the water in wells," and gave for comparative data the place, time, situation, soil, "depth of the well by estimation," and "natural heat of the atmosphere." Some of these observations were evidently taken on a trip to New Haven and Williamstown, for notes are given on a string of wells from Cambridge to New Haven and from Hartford to Williamstown. Similar observations were made in and around Cambridge on the temperature of spring water as compared with the temperature of the atmosphere.

There is nothing to indicate that Williams took systematic precipitation observations, except that we find one loose sheet, much browned with age, on which is written: "Dimensions of the Ombrometer. Length of one side, 14.15 inches. Area, or contents of the Tunnel, 200.2225 inches. *Measures.* With a tube of 20 cubic inches." "1. Tube 10 times full amounts to 1 in. in altitude," and so on down to "tube 2 tenths of an inch full is 0.001."

Most interesting of all the manuscript tables, however, as showing what systematic work had been done before Williams's time, is a little table headed "Observations of the Extreme Degrees of Heat and Cold in the Commonwealth of Massachusetts, made by Fahrenheit Thermometer." They extend from January 12, 1752, to December 12, 1786, and give the year, month, day, hour, and place (all in eastern Massachusetts), with short notes on the exposure of the thermometer and on the observer. At the end of the table appears the following:

> December 25, 1786. The above are all the observations of extreme heat and cold which I can collect. For many years after the first settlement of the country, thermometers were not in use. The earliest observations I can find were those of the late Dr. Winthrop, inserted in the Massachusetts Gazette, Jan. 31, 1765. They begin with the year 1752.

Aside from temperature observations of various kinds, Professor Williams carried on a series of experiments on evaporation on the Merrimac River.

Of the meteorological work done by Professor Williams's successor, Samuel Webber, very little is recorded. He took barometric observations from January, 1790, to June, 1807, using an instrument furnished by the Meteorological Society of the Palatinate (whose headquarters were at Mannheim) till 1802, and after that time one made by Champney, of London. In May, 1806, Webber resigned the Hollis professorship and became president of the university, a post which he held till the middle of July, 1810. There is no evidence that he taught meteorology during his professorship, tho he probably included a brief mention of it in his lectures.

The last Hollis professor of the earlier period of whose connection with meteorological teaching there is anything like a complete record is John Farrar, Webber's successor. The science had by this time advanced far beyond its position in Williams's day. This advance is reflected not only in Farrar's writings, but in the fulness and care with which he recorded and studied all sorts of observations. During his long service (1807–1836) Farrar gave a "Course in Natural Philosophy." Under the part headed "Astronomy, Section Atmosphere and Its Effects" he notes the blackness of the sky as seen from high mountains and balloons. To the atmosphere he ascribes the diffusion of sunlight. "If there were no atmosphere," he says, "the sun, even when near the horizon, would shine with the whole of its light, and instantly upon its setting we should find ourselves in profound darkness." The course in natural philosophy succeeded a course in pure mathematics, and began with the second term of the junior year. It was continued in the senior year, and came (as the president's report for 1828–29 states) "every morning in the week immediately after prayers." Professor Farrar spent the academic year 1831–32 in Europe for his health. The change evidently was not as beneficial as could be desired, for the president's report for 1832–33 says that he "was excused from all except lecture work." His decline in health is not to be wondered at. Besides his teaching and immense amount of private observation and study, he found time to make translations of the best French text-books of mathematics and natural philosophy. "Their wide introduction to American colleges," said Professor Lovering at a meeting of the American Academy of Arts and

[2] Delisle, at St. Petersburg, 1726–1736, used mercurial thermometers on which 0° was boiling point of water and 150° the freezing point. He thus avoided the frequent negative readings that occur in Russia. Possibly Hawksbee had the same intentions as regards New England winter temperatures, and put his 0° at the boiling point of alcohol. Up to 1750 each maker felt at liberty to modify the thermometer after his own notions.—*C. A.*

[3] The Mannheim scale of winds was 0, 1, 2, 3, 4.—*C. A.*

Sciences, in 1853, was "not the least important of the services rendered to science by Mr. Farrar."

In an elementary treatise on mechanics Professor Farrar devotes a considerable section to the barometer. At the end of it, in a series of "Notes," he gives additional information on the history of the instrument. Reference is made to the early belief that humid air was heavier than dry air and hence that the barometer ought to stand higher in rainy weather than in clear, and the fallacy of this belief is pointed out. Of the diurnal variation of the barometer in the Tropics he says: "Neither the wind, nor rain, nor fair weather, nor tempest disturb the perfect regularity of these oscillations."

Mention has already been made of Professor Farrar's personal observations. They were great in variety and astonishing in completeness. We can merely mention the principal points of interest about them here. His barometer was made by W. and S. Jones, London, and was provided with a floating gage and a scale of correction, and was graduated into English inches and hundredths. His temperature observations extended thru the years 1807–1812, 1813, 1816, and 1817. They were abstracted from time to time, together with Professor Webber's for the years 1790–1807, in the American Almanac. During the years 1800–1806 he made hygrometrical observations with a Daniels hygrometer, tabulating the results under "greatest," "mean," and "least," by months. His observations of a great storm which occurred in New England September 23, 1815, are very detailed as to wind direction and velocity, barometer, state of the sky, etc.

With the close of Mr. Farrar's activity as professor of mathematics and natural philosophy, in 1836, the record of the connection of Harvard with meteorology temporarily ceases. Not until thirty-four years later comes the first official mention of meteorology in the university, in the president's report for 1870–71. In that year, with the meteorological lectures of Professor Whitney, began the second and fuller development of the science at Cambridge. An account of this second period, which is seemingly quite independent of the earlier, would deal with the work of Whitney, Pettee, Shaler, Davis, Ward, Rotch, and others, also with the establishment of the Harvard College Observatory and of the Blue Hill Meteorological Observatory; but it would greatly exceed the limits set for this paper.

THE METEOR OF OCTOBER 5, 1907, OVER NEW JERSEY AND PENNSYLVANIA.

By Prof. HENRY A. PECK. Dated Syracuse, N. Y., May 28, 1908.

Saturday evening, October 5, 1907, at 9:55 p. m., eastern time, a very large meteor was seen to pass from a position over the ocean east of the New Jersey coast to the vicinity of Warren, Ohio. It was quite widely noticed in the daily press of the principal cities along its route, including New York, Philadelphia, Baltimore, and Washington. The steamer *Castilian Prince*, plying between Fernandina and New York, observed the phenomenon while coming up the New Jersey coast between Seagirt and Barnegat. Aside from the widely extended press notices, reports have been received from the following, the greater share being in response to a postal-card canvass conducted by the Central Office of the Weather Bureau:

ONTARIO, CANADA.

Deshler Welch, Niagara on the Lake.

NEW YORK.

Fred G. Wyman, Binghamton.
Louis Renault, Brooklyn.
Henry A. Morris, Brooklyn.
E. J. McLaughlin, Brooklyn.
William H. Orr, Buffalo.
Frank W. Cheney, Jamestown.
A. J. Lannes, Jamestown.
Frank J. Nash, Leroy.
Frank W. Ball, Leroy.
Maurice C. Ashley, Middletown.
William C. Thomas, New York.
Charles W. Hall, North Tonawanda.
E. Russell Davis, Norwich.
T. C. Sweet, Phœnix.
Paul A. Mackey, Poughkeepsie.
H. W. Nelson, jr., Poughkeepsie.
Robert Dunk, Scriba.
H. C. Townsend, Wappingers Falls.

NEW JERSEY.

F. C. Pierce, Imlaystown.
Bert Stiff, Jersey City.
William P. Bowne, Lambertville.
Mrs. John H. Brown, Long Branch.
Lewis B. Holt, Ocean Grove.
D. W. Smith, Phillipsburg.
P. Hardcastle, Somerville.
Dr. Franklin Chattin, Trenton.

PENNSYLVANIA.

Arthur B. Cornell, Allegheny.
Isaac D. Kreiss, Benjamin.
R. B. Headlee, Brock.
Mrs. C Swenson, Ambridge.
A. M. Orr, Greenville.
George H. Sprenkle, Hanover.
E. R. Demain, Harrisburg.
M. L Heisler, Harrisburg.
John Larimer, Leetsdale.
T. H. Weagley, M. D., Marion.
A. F. See, Meadville.
Thomas L. Becker, Newmanstown.
M. T Bretz, Newport.
Clyde Swartz, Nittany.
J. F Blair, Orrstown.
C. F. Clement, Philadelphia.
U. J. Stewart, Pine Bank.
Harry E. Adams, Pittsburg.
S. E. Smith, Reading.
J. G. Apple, Saegerstown.
Mrs. Alfred McElwain, Scenery Hill.
Benjamin W. Collins, Swarthmore.
George Q. Weaver, Talmage.
George Kralt, jr., Washington.
Dr. I. C. Green, West Chester.
Hannah M. Warrington, West Chester.
Mrs. Mabel A. Conrad, Woodhill.

DELAWARE.

H. S. Gray, Clayton.

MARYLAND.

Harry B. Mason, Denton.
Dr. Winfred T. Morrison, Elkton.
Henry Trail, Frederick.
E. A. McCulloch, Glencoe.
Joseph Plummer, Jewell.
James R. Stewart, Princess Anne.
C. W E. Treadwell, Towson.

DISTRICT OF COLUMBIA.

Thurbert H. Conklin, Washington.
Miss Kate S. Curry, Washington.
W. W. Saunders, Washington.
Herbert C. Hunter, Washington.

VIRGINIA.

H. H. Fox, Ashland.
Mrs. E. B. Kneiple, Broadway.
Lizzie M. Heatwole, Dale Enterprise.
S. E. Fletcher, Glenallen.
Samuel Brunk, Harrisonburg.
Frank Luke, Warrenton.

WEST VIRGINIA.

J. W. Thompson, Elkins.
R. F. Adams, Huntington.

OHIO.

John A. Wentz, Canton.
Edwin Vogelgesang, Canton.
Charles F. Stokey, Canton.
S. M. Painter, Fredericktown.
B. W. Adair, Leesville.
H. R. McClintock, Summerfield.
Prof. T. H. Sonnedecker, Tiffin.

The accompanying table, in which localities have been arranged by States and in order of longitude from east to west, presents notes as to the physical appearance of the meteor. No attempt has been made to harmonize discrepancies, but as far as possible the impression made upon the observer has been reproduced.

Several observers speak of a peculiar appearance of the sky at the point where the meteor first appeared.

Only two observers mention that the meteor separated into parts. These are both near the end of the flight. The phenomenon does not appear to have been sufficiently marked to attract general attention.

The point of disappearance.—Aside from the numerous hints contained in newspaper references and in inexact descriptions, four observers made records of the point of disappearance that admit of use for the purpose of computation. Thurbert H. Conklin, of Washington, D. C., makes note of the fact that the meteor apparently past behind a house in azimuth N. 50° W. and at an altitude of 5°. I am persuaded by a comparison of this observation with others that he saw the actual disappearance of the meteor. R. F. Adams, of Huntington, W. Va., records that it was last seen by him a little east of northeast. He also records that it first appeared almost directly east of his position. A glance at a map will show that this last statement can not be reconciled with the statement of those situated on the Atlantic coast. If his azimuths are corrected by 18°, both the beginning and the end of the flight are well represented. According to B. W. Adair, of Leesville, Ohio, the meteor disappeared 4° or 5° east of north. J. A. Wentz, of Canton, Ohio, reports that it past from sight at 11° south of east. This seems to be an error, however, as E. L. Vogelgesang, of the same place, reports that it came from a

TABLE 1.—*Observations on the meteor of October 5, 1907, over New York, New Jersey, Pennsylvania, and Ohio.*

Place.	Color of meteor.	Size of meteor.	Intensity of light.	Color of light.	Train.	Noise.	Duration of visibility
Wappingers Falls, N. Y.			Brighter than electric light 200 feet distant.	Light orange.	Lasted 5 seconds.	No noise heard.	6–8 seconds.
Poughkeepsie, N. Y.	Dark orange						4 seconds.
Shortsville, N. Y.	Reddish.						
Leroy, N. Y.							2–3 seconds.
Jamestown, N. Y.			Bright enough to read by.		Bluish	No noise heard.	15–20 seconds.
Long Branch, N. J.				Bluish			
Ocean Grove, N. J.		One-half size of full moon.		Yellowish			
Trenton, N. J.	Red.				Long, green		
Philadelphia, Pa.					Gradually contracted into a fish-hook shape.		
Benjamin, Pa.			Electric lights dwarfed.				
Swarthmore, Pa.				Green and yellow.	The part that formed first disappeared last. After 4 minutes it resembled the Milky Way.	No noise heard.	
South Scranton, Pa.	Reddish					Loud explosion	
West Chester, Pa.					Lasted 5 minutes.		
Reading, Pa			Equaled 1,000-candlepower street lamp.				
Birdsboro, Pa.				Bluish		No noise heard.	
Newmanstown, Pa.				Bluish		Jar or sound 2 minutes after.	
Hanover, Pa	White, with yellow tinge.		Shadows of trees moved		Pale green, faint haze.	Explosion	50 seconds.
Dauphin, Pa.						Roar	
Allegheny, Pa.		A blazing ball of fire.					
Ambridge, Pa.					Fan shaped		
Leetsdale, Pa	Red hot copper.		Strong as full moon	Yellow.		Quite a noise	
Washington, Pa.			As light as day.		Like a cloud of smoke.		
Pine Bank, Pa				Bluish			30 seconds.
Clayton, Del							3 seconds
Elkton, Md							5–10 seconds.
Glencoe, Md.						Loud blasting 1 to 1½ minutes after.	
Jewell, Md.				Greenish			
Towson, Md.						Houses trembled	
Washington, D. C.							4 seconds.
Broadway, Va.					Great streak of bright light		
Harrisonburg, Va.		One-fourth size of moon.					4–5 seconds.
Glenallen, Va.				Bluish			4–5 seconds.
Huntington, W. Va.				White like a gas mantle.			
Canton, Ohio.		One-half size of moon.					1–2 seconds.

point on the eastern horizon, a little south of the vertical circle passing thru the point where the belt of Orion rises, and that it past to the north. Using the method of intersecting azimuth planes, the point at which the meteor disappeared is found to be situated vertically over longitude 81° 1′ west, latitude 41° 17′ north. This position is fairly well supported by the other data.

The meteor is somewhat peculiar in that it apparently failed to penetrate the lower levels of the atmosphere. While the evidence is rather scanty, it is quite consistent. The elevation of the point of disappearance as given by the Washington observation is 24 miles; Canton observation 28 miles; North Tonawanda observation 20 miles; and Orrstown observation 17 miles. The average of these places the point of disappearance at an altitude of 22 miles above the surface, near the boundary line between Trumbull and Portage counties, Ohio, and about 10 miles north of west from the city of Warren.

The apparent position of the radiant.—The track of a meteor as seen by an observer is the projection upon the heavens of the essentially straight line it describes in passing thru the atmosphere. The right ascension and declination of two points on one of these projections establish an equation. The solution of the equations representing all the observations is accomplished by the least square method and furnishes the right ascension and declination of the point at which visible flight began as seen from the end of the line. In order to use observations where the position of only one point has been noted, the common method is to calculate the coordinates of the end of the path from data already established and use the result in the place of the observed positions of this point. These computed coordinates may be combined with those of any observed point of the projection to form an equation. In using this method, the observations given in columns 2 and 3 of Table 2 were selected as suitable.

TABLE 2.—*Position of meteor.*

Place.	Azimuth.	Altitude.	a	δ	a'	δ'	Position of track. Γ	Position of track. γ
	°	° ′	° ′	° ′	° ′	° ′	° ′	° ′
Camden, N. J.	0	90	242 17	+14 5	342 47	+39 56	216 41	42 59
West Chester, Pa.	0	90	240 26	+16 27	341 44	+39 57	222 30	43 50
Reading, Pa.	S 45 E	68	243 33	+12 59	358 18	+23 29	42 2	147 51
Elmira, N. Y.	S 25 W	6 40	258 48	− 5 3	309 7	−36 17	253 4	138 30
Hanover, Pa	N 30 E	45	235 21	+22 44	47 15	+67 23	234 9	87 8
Washington, D. C.	N 40 E	8	225 12	+31 50	100 10	+42 33	71 7	62 7
Orrstown, Pa	S 30 E	17	236 1	+23 11	50 27	+ 3 30	231 9	78 47
Leroy, N. Y.	S 67.5 E	22 30	257 5	−24 6	38 00	+ 0 7	217 50	144 44
Canton, Ohio	S 79 E	35	44 22	+68 46	32 27	+14 52	211 6	95 6

If a and δ represent the apparent right ascension and declination of the end of flight as viewed from the various stations and a' and δ' represent the corresponding coordinates computed from the azimuths and altitudes given, we have the values given in columns 4 to 7 of the table.

If γ denote the inclination of the track of the meteor to the equator of the heavens and Γ the longitude of its ascending node, these quantities may now be found from the equations,

$$\tan\gamma \sin(a'-\Gamma)=\tan\delta'$$
$$\tan\gamma \cos(a'-\Gamma)=\frac{\tan\delta-\tan\delta'\cos(a-a')}{\sin(a-a')}$$

with the results given in the last two columns of Table 2.

If A and D denote the right ascension and declination of the apparent radiant, or point from which the meteor appeared to come, the following equation must be satisfied:

$$\sin\Gamma\sin\gamma\cos D\cos A-\cos\Gamma\sin\gamma\cos D\sin A+\cos\gamma\sin D=0.$$

This may be readily put in the form of an equation containing two unknown quantities. From the nine equations thus

formed there results, as the most probable value of the coordinates of the radiant,

$$A = 51° 10'$$
$$D = -35° 1'$$

In the present case there are two methods by which this result can be tested. First, it must satisfy the nine observations within reasonable limits; and secondly, when the right ascension and declination are converted into azimuth, the line indicated must pass thru the zenith of the place occupied by the *Castilian Prince*. On substituting in the equations from which the result is produced, very large residuals are found to exist for the last two stations. This is quite natural, considering their distance from the point of the meteor's first appearance. The azimuth derived from this radiant passes near Cape May, which is too far south. If the equations for these last two observations are abandoned, the position of the radiant is

$$A = 57° 17'$$
$$D = -15° 51'$$

and the meteor would have past thru the zenith of all places whose azimuth as seen from the end point was S. 72° 11′ E. The probable azimuth of the *Castilian Prince* was S. 73° 18′ E. From this agreement we may safely assume the above to represent the coordinates of the apparent radiant point.

The length of the path.—The most unsatisfactory data are those upon which depends our knowledge of the altitude at which the meteor began to glow. There are only two observations that one can use with any thing approaching certainty. These are Hanover, Pa., 61 miles; Orrstown, Pa., 70 miles, the average of which gives 65 miles as the most probable height above the surface. Fortunately the length of the path was so great that a considerable discrepancy in our knowledge of the altitude would have small effect on the resulting velocity. The probable length of the path approximates 385 miles.

The velocity thru the atmosphere.—The duration of visibility, when stated by the observer, is given in the last column of Table 1.

It is always a delicate question to decide which estimates are obvious errors and to which the law of probability can be safely applied. In the present instance, the Hanover observation has been rejected and the average of the remainder taken as the most probable value. Dividing the length of the path by the duration of visibility the velocity thru the atmosphere is 50 miles per second.

The path with regard to the sun.—From the Nautical Almanac it is found that the longitude of the sun was 191.7° and therefore the longitude of the apex of the motion of the earth was 102.6°. The angle between the true path of the meteor and that of the earth was 81.1° and the velocity thru the atmosphere was therefore greater then the velocity in space. The velocity in space before it fell under the attraction of the earth was 43.7 miles per second. The coordinates of the true radiant, or direction in space from which the meteor came, are celestial longitude, 24° 24′; celestial latitude, −40° 24′.

Making use of the known formulas of theoretical astronomy, the elements of the solar orbit [i. e. of the meteor's orbit about the sun] are easily deduced as follows: Longitude of ascending node, 11° 41′; inclination to ecliptic, 104° 14′; longitude of perihelion, 74° 38′; log. of perihelion distance, 9.7495; log. of eccentricity, 0.4790.

NOTE ON SOME METEOROLOGICAL USES OF THE POLARISCOPE.

By DR. LOUIS BELL. Dated January 27, 1908.

[Reprinted from the Proceedings of the American Academy of Arts and Sciences, March, 1908.]

This is merely a preliminary notice of certain facts regarding atmospheric polarization which may prove to have some prognostic value. They were incidental to a proposed study of the character of autumnal haze which the writer undertook last year at Mount Moosilauke, N. H. This peak, 4,811 feet high, has an almost uninterrupted sweep of horizon over a radius of 100 miles or so, and offers an excellent chance for investigating the distribution and nature of the haze that veils the landscape in early autumn. For instruments I took along a Savart polariscope, merely a Savart plate with a bit of tourmaline as analyzer, an extemporized double-image polarimeter of the type outlined in the early and valuable paper of Prof. E. C. Pickering,[1] a couple of carefully calibrated photographic wedges for determining opacities, and a direct vision spectroscope.

A prolonged easterly storm, about the only thing which could have defeated the program, cut short observations upon the summit, but a week of preliminary observations at Breezy Point (elevation 1,650 feet) at the base of the mountain yielded results which seem to be of sufficient interest to put upon record.

These were made mostly with the Savart polariscope, an instrument which, from its very wide field of view and great sensitiveness, showing even one or two per cent of polarization, enables sky conditions to be very readily investigated. The character of the sky polarization, with its general symmetry and maximum in a plane of 90° solar distance, is well known, but the nature and causes of its casual variations have not, perhaps, received the attention that is their due. Nearly everything in the landscape polarizes by reflection to a greater or less extent, the more as the specular component of reflection is the greater. For example, the glossy upper surface of a maple leaf polarizes strongly at fairly large angles of incidence, while the mat lower surface has only a trifling effect —which facts explain the old observation of Spottiswoode that ivy leaves polarize particularly well. Grass, trees, stones, especially if wetted, all produce their effect, which, when sky polarization is cut off by white cloud, is generally a maximum in the vertical plane.

I have several times observed this terrestrial polarization carried up by reflection into low-lying cloud as noted by Pickering (loc. cit.), or even into near-by dense fog otherwise neutral. A completely cloudy sky is otherwise practically free of polarization, but in a partially clear sky white cumuli commonly show some effects with the Savart plate, and light cirri often give bands almost as strongly as the clear sky. This may be due to the usually considerable height of cirri,—quite enough to allow noticeable polarization to have origin below them—or to their letting thru considerable polarized sky light from above—a phenomenon which I observed from the summit station in the case of rather thin layers of cloud in which it was immersed.

One of the most striking features of the sky polarization observed from Breezy Point was the extent to which it appeared while originating over short stretches of air. Mounts Kineo and Cushman, about three miles distant and dark with a heavy growth of conifers, repeatedly showed strong polarization effects from intervening haze, and at times slopes within a mile brought out the bands, altho less conspicuously. On several occasions the polarization on Kineo and Cushman was sensibly as considerable as on peaks at 10 or 15 miles distance. Similarly, in the brief observations on the summit, the Green Mountains, and the almost effaced Adirondacks, showed little if any more polarization than the peaks in the same direction in the middle distance, altho the former were 80 to 100 miles and the latter only 20 to 40 miles. These results follow from the exponential relation between distance and apparent absorption, but show clearly the magnitude of the effects due to comparatively short reaches of air.

At no time was I able to repeat the results obtained by Tyndall in the apparent clearing up of the haze by observation thru a crost Nicol. In this case the mountains remained

[1] Proceedings of the American Academy of Arts and Sciences, Vol 9, p. 1 et seq.

dim, Nicol or no Nicol, showing that the typical autumnal haze, often whitish blue near the horizon, acts mainly by general obstruction and diffusely reflecting a good deal of light, the polarized component being usually only moderately strong.

Haze in general is well known to be due simply to suspended particles of one sort or another, and haze which produces polarization, as well as the ordinary sky polarization, is well known to be due to particles, whether of dust or water, or of other nature, small compared with the wave-length of light. Lord Rayleigh[2] has given the theory of this action in considerable detail.

The polariscope integrates the effect of such particles along the line of sight, and this information may have considerable meteorological significance. The light-scattering particles which produce sky polarization are much finer than those which produce coronas and similar phenomena, with the beginnings of ordinary reflection. In artificial fogs the nuclei gradually grow from the polarizing dimensions to those which scatter white light and become visible. It is not easy to assign exact dimensions to the finer particles. They are quite certainly much less than a quarter wave-length in diameter, that is, say 100 $\mu\mu$, and probably run very much smaller. From the very exhaustive work of Barus[3] it appears that the diameter of the particles to which visible fog and coronas in a fog chamber of laboratory dimensions are due range from .0005 μ upwards, those near this limit showing as fog, while the coronas began to form as the diameters reached 10 μ and above. The fog particles to which lunar coronas are due often rise to greater dimensions, 20 or 30 μ.

Now such fog particles are the preliminary to rain, which forms by the accretion of these particles to a size that readily falls; and it is well known that water vapor, even when saturated as shown by the psychrometer, will not begin to condense to visible fog unless in the presence of nuclei about which aggregation takes place. These may be of very fine dust, or even of water particles electrically charged to an extent that resists the surface tension that would otherwise promote evaporation. Such charged aqueous nuclei may exist in unsaturated air at very small diameters, down to 1 or 2 $\mu\mu$, as has been shown by J. J. Thomson,[4] by Wilson,[5] and by others. Between these almost molecular dimensions and those indicated by coronas are the light scattering particles active in sky polarization. Their effect, that is, the amount of light scattered, varies, as Rayleigh[6] has shown, as the inverse fourth power of the wave-length of the light affected and directly as their volume, assumed to be small compared with a wave-length. Now plotting the resulting equation, $I = \frac{\kappa A}{\lambda^4}$, one obtains a group of curves shown in fig. 1 [omitted], which discloses the cause of the familiar intense blue of the scattered light. As larger particles grow during the process of nucleation or are present as dust, the blue gets weak and whitish from the scattering of white light. Near the horizon, where the light traverses a long reach of atmosphere and coarser dust is common, one gets the familiar weakening of the sky blue.

The process of increasing nucleation, which results in cloud formation and frequently in subsequent rain, can be followed very closely by the polariscope. A fall in polarization, particularly when the spectroscope shows the presence of much aqueous vapor, indicates the progress of nucleation.

On several occasions I noted this phenomenon in the Breezy Point observations. Starting with strong polarization on the distant hills to the southward and a strong rain band visible in the spectroscope, the next few hours showed a conspicuous weakening of the polarization, followed presently by the formation of visible clouds, and in at least two cases by precipitation. In short, if from change of temperature or other cause cloud is due to form in any particular direction, the nucleation which precedes visible fog formation is bound, other things being equal, to cut down the polarization. The prognostic value of this process depends largely upon the rate at which it progresses. In two instances which I noted, the decrease toward the south occupied most of an afternoon. Of course a drifting in of coarser dust particles would produce weakening of polarization, but the concurrence of weakening with a heavy rain band intimates very strongly that nucleation is progressing.

A detailed study of the changes would require the use of a sensitive polarimeter, by which variations from the theoretical polarization could be accurately measured. Observations of this kind, made where there is a wide sweep of horizon, should frequently disclose incipient cloud formation and the causes which produce it. The use of a spectro-polarimeter would be very desirable, as showing by the change in the quality of the scattered light the progress of events. The nature of the minute nuclei, whether dust or water particles, is not definitely known. After a heavy rainstorm the lower strata seemed to have been cleared pretty effectively of polarizing nuclei, while the upper sky remained much as before. On one occasion, more than twenty years ago, I was taking rain-band observations on Moosilauke and was favored with a day in which the distant peaks, even up to 100 miles, stood out almost as black as silhouettes, while the sky took on a deep hue almost startling in its unfamiliarity. A polarimeter would certainly have given extremely interesting results had it been at hand. It seems quite possible that one might get a fairly clear idea of the relative number and distribution of nuclei in the upper air by such means.

It would certainly be interesting also to find out whether the apparently very strong absorption of ultra-violet rays by the atmosphere is due to any genuine absorption or merely to a serious loss of light by lateral scattering, which Rayleigh has shown may perhaps be due to the air molecules themselves. In the lower strata my observations pointed rather to dust than to minute water nuclei, since a whitish haze showed powerful polarization on near-by peaks, making it clear that the haze was extremely heterogeneous. The conditions which would produce stable water nuclei of strongly polarizing size on a clear day would tend to reduce larger droplets to the similar order of magnitude instead of leaving them to superimpose specular reflection.

I am not disposed to suggest that in the polariscope we have a meteorological tool of vast importance, but my preliminary observations certainly show that it gives a most instructive view of the very early stages of atmospheric nucleation, and especially if combined with rain-band observations it should have material prognostic value as regards comparatively local conditions. There is also a chance for forming a clearer idea of the conditions of nucleation in the upper air, including the very high altitudes, since polarization is manifest after the sun is so far below the horizon as to illumine only the upper strata. I bring the preliminary facts to notice here in the hope that some one with a suitable location and opportunity for systematic observation may find them useful as a guide to further work along this line.

[2] Phil. Mag., 1871, p. 107 et seq.
[3] Smithsonian Cont., No. 1373.
[4] The Discharge of Electricity thru Gases. [5] Phil. Trans., 1897.
[6] Rayleigh, loc. cit.

NOTES FROM THE WEATHER BUREAU LIBRARY.

By C. FITZHUGH TALMAN, Librarian.

UPPER AIR RESEARCH IN GREAT BRITAIN.

The active part that British observers are now taking in the world-wide campaign of upper air research was reflected in the prominence given to this topic at the last Royal Society conversazione held at Burlington House, May 13, 1908. The sub-

ject was illustrated by exhibits by Dr. W. N. Shaw, J. E. Petavel, W. A. Harwood, C. J. P. Cave, Capt. C. H. Ley, E. S. Bruce, and the director of the Egyptian Survey Department.

Daily ascents are now made at the Howard Estate Meteorological Station of the University of Manchester, situated at Glossop Moor, Derbyshire, and the results are published in a monthly bulletin. The work at this station is to continue for two years from January 1, 1908. The necessary funds were mainly contributed by Dr. Arthur Schuster, of the University of Manchester, and Mr. J. E. Petavel has immediate charge of the observations.

Upper air observations are made by Mr. Dines, for the Meteorological Office, at Pyrton Hill, Oxfordshire, by Mr. Cave at Ditcham Park, Petersfield, and by Mr. S. H. K. Salmon at Brighton. In connection with the scheme of simultaneous observations under the direction of the International Committee on Scientific Aeronautics observations have been made during the past year at several other points in the British Isles.

A METEOROLOGICAL STATION ON THE ELBRUZ.

Globus of May 7, 1908, announces that a project is on foot to erect a meteorological and astronomical station on Mount Elbruz (18,526 feet), the highest summit in the Caucasus. The estimated cost, 20,000 rubles, the president of the Caucasus Alpine Club, M. Leutzinger, hopes to raise in part from various learned societies.

This giant mountain, which forms a conspicuous feature of the landscape of southeastern Russia, is much higher than Mont Blanc, and, we believe, than any other mountain that is at present the site of a meteorological station.

ENGLISH ABSTRACTS OF JAPANESE METEOROLOGICAL PAPERS.

The monthly Journal of the Meteorological Society of Japan, now in its twenty-seventh year, has begun publishing English abstracts of the Japanese contents of each number. This excellent innovation makes available to occidental readers a wide range of meteorological literature, as may be judged from the following titles of abstracts published in the number for March, 1908:

M. Ishida—Diurnal variation of the wind velocity.
K. Asakura—Relation of the climate and tobacco cultivation.
M. Sato—Meteorological observations at sea.
J. Sato—On cloudy morning weather.
H. Ogiwara—The climate and rice crops.
Y. Takashima—Precipitation near Mokpo.
K. Asakura—Remarkable rainfall at Yokohama on January 15, 1908.
M. Ishida—Climate of south China.

The paper last named is a summary of observations made for the last three years at Hangchow, Nanking, Hankow, and Shashi, and is one of the first fruits of the recent invasion of China by the Japanese meteorologists.

METEOROLOGICAL EXPLORATION IN KAMCHATKA.

The Scottish Geographical Magazine states that a large exploring expedition, organized by M. T. P. Riabouchinsky, left St. Petersburg in May for Kamchatka. Meteorology is one of the principal subjects to be pursued by the expedition, which will spend eighteen months in Kamchatka. Meteorological stations will be established at Tigil, Kintchevska village on the Kamchatka River, and Petropavlovsk.

THE SYMONS MEDAL.

The Symons Memorial Gold Medal, which is awarded biennially by the Royal Meteorological Society, has been presented this year to M. Léon Teisserenc de Bort.

M. Teisserenc de Bort was a member of the staff of the Bureau Central Météorologique de France from 1878 to 1892. In the latter year he resigned in order to devote his entire attention to experimental research in meteorology, and in 1896 he founded a private observatory for the study of dynamic meteorology at Trappes, near Paris. His recent work has been chiefly in the field of upper air research, including the well-known expeditions of the yacht *Otaria* (in connection with Mr. A. Lawrence Rotch), and the comparison of upper air temperatures in different latitudes.

EXHIBITION OF METEOROLOGICAL AND GEOPHYSICAL INSTRUMENTS.

An international exhibition of meteorological and geophysical instruments will be held at Faenza, Italy, in connection with the celebration of the tercentenary of the birth of Torricelli, during the months of August, September, and October of this year. A prize of 2,000 francs will be awarded to the meteorological or geophysical instrument exhibited that is judged to be the best innovation, either from its principle or from its application to some principle already known.

WILLIAM M. HUSSON.

Mr. William M. Husson, whose death in his 53d year, occurred in Washington, D. C., on May 10, 1908, entered the Weather Bureau Service in August, 1890, and served continuously as draftsman at the Central Office, with the exception of about a year during the war with Spain when he was engaged in the military service of the United States as Captain of Company D, 1st Regiment, Florida Volunteers. He was a skilful and intelligent workman and a man of excellent character and disposition.—*H. E. W.*

ICE MOVEMENTS AND CURRENTS IN BERING STRAIT.

Mr. James F. Cross, Government teacher at Wales, Alaska, has for the past three years kept notes of the ice movements and currents in Bering Strait. This spring, on May 28, in response to a request from the special observer of the Weather Bureau at Nome, Alaska, he telegraphed the following information:

April 6.—Ice all clear from the straits and was open water to the Diomedes [Islands] and as far north and south as you could see. Current moving south.

April 11.—Current changes and brought ice into the straits for five days.

April 17.—Current south. Ice cleared and water full of young ice. Since this date no ice floes have come into the straits, and as far as you can see the water is open. The natives are not able [to] account for no ice coming down with both the wind and current from the north.

April 27.—Strong current from the south. Wind northeast, but the ice did not move up from the south. The current varies from day to day. As the only way to measure is by the floating ice it is hard to estimate velocity. Compared with other years there is much less ice in quantity. A letter dated February 23, at Icy Cape, says: "The ice pack did not come down from the north." Last reports from the Diomedes Islands indicate that the ice in the west straits has been light and there is now plenty of open water there. Walrus are running in large numbers east of Diomedes Islands.

CORRIGENDA.

MONTHLY WEATHER REVIEW for March, 1908, Vol. XXXVI, No. 3, Chart XIV, in lower left-hand corner the legends for the two colors, green and red, should be interchanged, making *red* indicate "Not crost by paths" and *green* "crost by paths."

MONTHLY WEATHER REVIEW for April, 1908, Vol. XXXVI, No. 4, page 87, column 1, second line of text of "Chinook winds, etc.," for "Charts IX and X" read "Charts XVI and XVII". Page 103, column 2, in Table 1, left-hand column, for "Ghent" read "Geneva". Page 105, in Table 4, right-hand column, line for July, for "0.495" read "0.0495".

AN ELEMENTARY METHOD OF DERIVING THE DEFLECTING FORCE DUE TO THE EARTH'S ROTATION.

By T. OKADA. Dated Tokyo, Japan, May 9, 1908.

1. If a body be supposed to move without friction on the surface of the rotating earth, a single impulse would give to it a perpetual motion, but the motion could not be along a straight path. The rotation of the earth modifies the motion of the body in two aspects. First, the motion of the body seems *apparently* modified to the observers resting on the surface of the earth, and rotating with the latter. Second, the rotation of the earth alters *actually* the initial velocity of the moving body. Hence the body would be continuously deflected to one side of its instantaneous path, that is, to the right in the Northern Hemisphere and to the left in the Southern Hemisphere.

In forming the equations of motion of the moving body we have therefore to add to the acting forces another force called the deflecting force due to the earth's rotation, supposing that the earth stands still and the continuous deflection of the moving body is caused by the force just mentioned.

If ω be the angular velocity of the earth's rotation, v the velocity of the moving body, m its mass, and φ the latitude, the expression for the so-called deflecting force is $2mv\omega \sin\varphi$.

The rational methods of deriving the deflecting force given in treatises on mechanics, such as Kirchhoff's, are very difficult for beginners to understand, and the physical ideas involved in their elegant analyses are not to be easily grasped. On account of the great importance which the deflecting force bears to the motions of the earth's atmosphere, several meteorologists have attempted to derive it from various points of view, and some of them have, without the aid of higher mathematics, so derived it as to make their methods intelligible to most elementary readers. In their methods, however, they introduce the term "centrifugal force," a very convenient term when it is rightly understood, but extremely misleading for beginners.

In the present note I have made an effort to derive the deflecting force without the use of higher analysis, avoiding at the same time the term "centrifugal force."

2. *West-east motion.* A body that is at rest at any place on the earth's surface has a steady motion around the circle of latitude of that place, and the attraction of the earth has to furnish the force necessary to produce the acceleration required by the motion of the body with the earth. The acceleration due to gravity is thus altered in magnitude and direction from this cause.

Let a be the attraction of the earth on the body. Regarding the earth as a sphere, we take PC (in fig. 1) as the direction of A and PQ its magnitude. Resolve A into two components, one PR along the radius PE of the circle of latitude and the other PS in the direction of PD, making a small angle δ with PC.

The component PR furnishes the force required by the body for its motion in the circle of latitude, and its magnitude is

$$PR = m\omega^2 r \cos\varphi,$$

where r denotes the mean radius of the earth. PS represents the force of gravity at the point P, and is normal to the earth's surface. It gives the initial acceleration g of the body.

SM is the perpendicular to PC from S.

In the triangle PQR we have

$$\frac{\delta}{\sin\varphi} = \frac{m\omega^2 r\cos\varphi}{PS}.$$

Since δ is a very small angle, we have

$$PS = PM = PQ - QM \quad \therefore \quad PS = a = m\omega^2 r\cos^2\varphi,$$

$$\text{and } \delta = \frac{m\omega^2 r\sin\varphi\cos\varphi}{a - m\omega^2 r\cos^2\varphi}.$$

Now suppose that the body is moving with a uniform velocity v on the circle of latitude from west to east. The angular velocity of the body is

$$\left(\omega + \frac{v}{r\cos\varphi}\right)^*$$

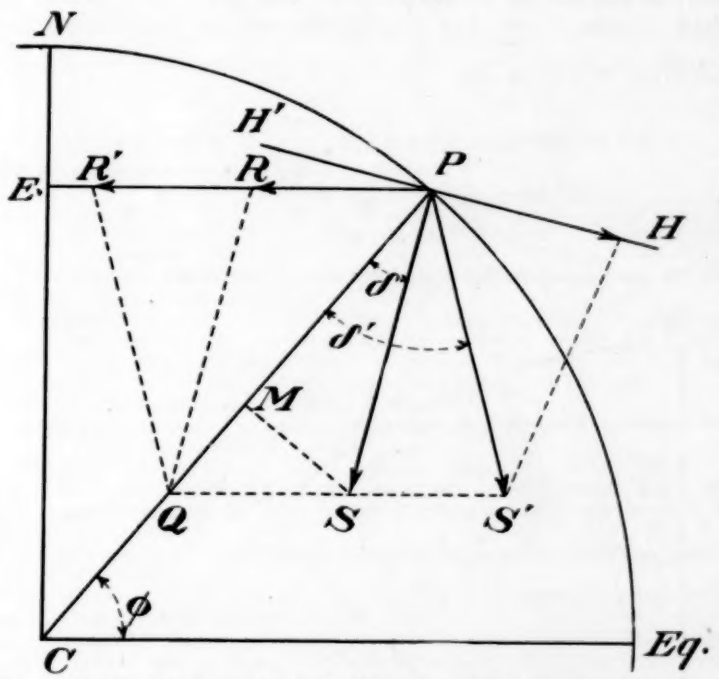

Fig. 1.—Section along earth's axis, thru part of Northern Hemisphere, showing cause of deflection of a body moving eastward or westward.

and the component force along PE is a little greater than PR. Denote this component force by PR'. Then the other component will be PS', making the angle δ' with PC. Here δ' is greater than δ.

$$PS' = a - m\left(\omega + \frac{v}{r\cos\varphi}\right)^2 r\cos^2\varphi.$$

$$\delta' = \frac{m\left(\omega + \frac{v}{r\cos\varphi}\right)^2 r\sin\varphi\cos\varphi}{a - m\left(\omega + \frac{v}{r\cos\varphi}\right)^2 r\cos^2\varphi}$$

$$= \frac{m\omega^2 r\sin\varphi\cos\varphi + 2m\omega v\sin\varphi}{a - m\omega^2 r\cos^2\varphi - 2m\omega v\cos\varphi}$$

We neglect two very small terms,

$$\frac{mv^2}{r} \text{ and } \frac{mv^2\sin\varphi}{r\cos\varphi},$$

in the denominator and numerator, respectively.

$$\Delta\delta = \delta' - \delta \doteq \frac{2m\omega v\sin\varphi}{a - m\omega^2 r\cos^2\varphi - 2m\omega v\cos\varphi}$$

When the body is at rest, the force of gravity acting on the body is perpendicular to the earth's surface, the horizontal plane HH', but when it is moving HH' is not the level surface for it. In this case the component of the earth's attraction acting on the body has the component PH along the surface HH' by which the body is forced to deflect its course of motion. This component is the "deflecting force due to the earth's rotation," which is

$$f = PS'\sin\Delta\delta = PS' \times \Delta\delta = 2m\omega v\sin\varphi.$$

* In case of motion from east to west, the angular velocity of the moving body becomes $\left(\omega - \frac{v}{r\cos\phi}\right)$, and δ' is a little less than δ. Hence the body is deflected polewards.

3. *South-north motion.*† Suppose a body has moved from P to Q (fig. 2) the time t which is supposed to be so small that the velocity of the body may be assumed as constant during the interval. Since the body has the eastward velocity $\omega r \cos \varphi$ at P and $\omega r \cos \varphi'$ at Q the eastward displacement of the body at the end of the time t is $\omega r (\cos \varphi - \cos \varphi')t$ which we shall denote by s. Let the velocity of the body along the meridian be v, then $PQ = vt = r(\varphi' - \varphi) \div \frac{vt}{\varphi' - \varphi}$

$$s = \omega r (\cos \varphi - \cos \varphi')\, t = \frac{\omega v t^2}{\varphi' - \varphi} (\cos \varphi - \cos \varphi')$$

$$= \frac{\omega v t^2}{\varphi' - \varphi} \left(2 \sin \frac{\varphi' - \varphi}{2} \sin \frac{\varphi + \varphi'}{2} \right)$$

$$= \frac{\omega v t^2}{\varphi' - \varphi} \times 2 \frac{\varphi' - \varphi}{2} \sin \varphi = \omega v t^2 \sin \varphi.$$

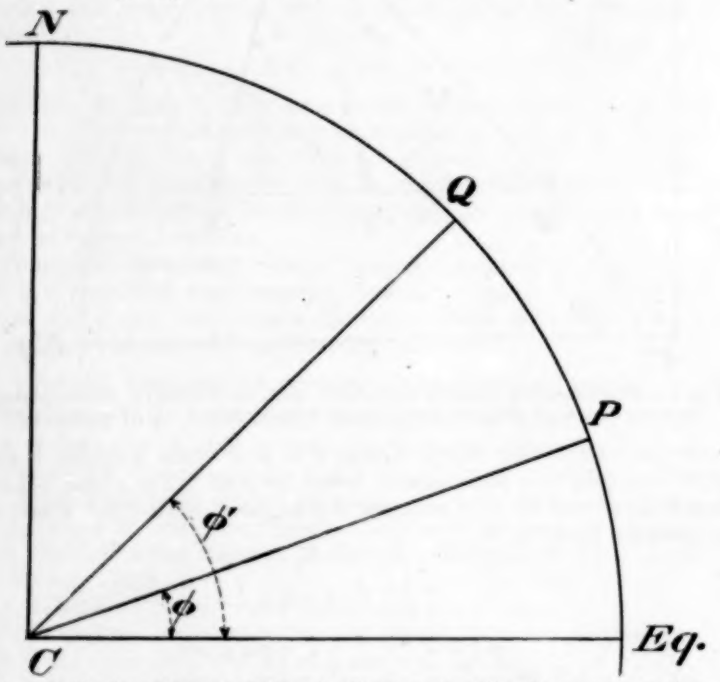

Fig. 2.—Section along earth's axis, thru part of Northern Hemisphere, showing cause of deflection of a body moving northward or southward.

Considering that this eastward displacement is caused by the so-called "deflecting force due to the earth's rotation" we have

$$s = \tfrac{1}{2} a t^2,$$

where a denotes the acceleration of the force.

$$\therefore f = m \frac{2s}{t^2} = 2 m \omega v \sin \varphi,$$

which is the same as in the case of the west-east motion. Hence, whenever a body moves in any direction on the earth's surface, there is a force ($2 m\omega v \sin \varphi$) arising from the earth's rotation which tends to deflect the body to the right in the Northern Hemisphere, and to the left in the Southern.

RECENT ADDITIONS TO THE WEATHER BUREAU LIBRARY.

C. FITZHUGH TALMAN, Librarian.

The following titles have been selected from among the books recently received, as representing those most likely to be useful to Weather Bureau officials in their meteorological work and studies. Most of them can be loaned for a limited time to officials and employees who make application for them. Anonymous publications are indicated by a ——.

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Rathschläge über den Blitzschutz der Gebäude. Berlin. 1905. v, 240 p. 8°.

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18. Jahrg. 1907. Leipzig. 1908. viii, 372 p. 8°.

Koch, Peter Paul.
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Same. 1905. 51. anno. Lisboa. 1907. v. 43. 127 p. f°.
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Luftelektrizität und Sonnenstrahlung. Leipzig. 1903. 24 p. 8°.

Schulz, Paul.
Klimaschwankungen im Norddeutschland und ihr Einfluss auf die Ernteerträge. Inaug. Diss. .... Halle. Halle a. S. 1907. 51 p. 8°.

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16ter Jahresbericht für das Jahr 1907. Wien. 1908. 48 p. 4°.

RECENT PAPERS BEARING ON METEOROLOGY AND SEISMOLOGY.

C. FITZHUGH TALMAN, Librarian.

The subjoined titles have been selected from the contents of the periodicals and serials recently received in the Library of the Weather Bureau. The titles selected are of papers or other communications bearing on meteorology or cognate branches of science. This is not a complete index of the meteorological contents of all the journals from which it has been compiled; it shows only the articles that appear to the compiler likely to be of particular interest in connection with the work of the Weather Bureau. Unsigned articles are indicated by a ——

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† The idea involved in this method is due to Dr. P. Schreiber, but it is more generalized in the present note. See his excellent treatise "Studien über Luftbewegungen." Leipzig, 1898.

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Ishida, M. Diurnal variation of the wind velocity. [Abstract, English.] p. 1–2.

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Takashima, V. Precipitation near Mokpo. [Abstract, English.] p. 4.

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Okada, T. Geometrical constructions for determination of the center of a cyclone. [English.] p. 9–12.

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Petavel, J. E. Investigation of the upper atmosphere. (May 21, 1908.) p. 56–57.

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Stanton, T. E. Wind pressure. (May 28, 1908.) p. 79–82.

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Mill, Hugh Robert. Map studies of rainfall. p. 65–86.

Browett, Charles. Formation of snow rollers. [Includes numerous extracts giving descriptions of snow rollers.] p. 87–96.

Gold, Ernest. Comparison of ship's barometer readings with those deduced from land observations; with notes on the effects of oscillatory motion on barometer readings. p. 97–111.

—— John Pearse Maclear. [Obituary notice.] p. 135–136.

—— Henry Chamberlaine Russell. [Obituary notice.] p. 137.

—— Maurits Snellen. [Obituary notice.] p. 137–138.

Parcou, R. Tropical and subtropical cyclones in northwest of Madagascar. p. 155–156.

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D., F. W. H. C Russell. 1836–1907. p. lx–lxiii.

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Shepstone, Harold J. The first weather plant observatory. p. 280–281. (May 2, 1908.)

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—— Störmer's work on the physics of the aurora. [Review.] p. 23–24.

—— The influence of the presence of radioactive deposits upon atmospheric electricity measurements. [Abstract of paper by Kurz.] p. 38–39.

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Kremser, V. Der Einfluss der Grossstädte auf die Luftfeuchtigkeit. p. 206–215.

Hann, J. Das Problem der vertikalen Temperaturverteilung im östlichen Mittelmeer. p. 215–219.

Hann, J. Die tägliche Variation der Windstärke auf den Berggipfeln in Sudindien in ihrer Beziehung zu der täglichen Luftschwankung. p. 220–222.

Ficker, H. von. Einfluss der Mitteltemperatur einer Luftsäule auf den Luftdruck an der Basis der Säule. p. 222–226.

Bemmelen, W. van. Beobachtungen über Richtung und Geschwindigkeit des Cirruszuges in Batavia. p. 226–228.

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—— Resultate meteorologischer Beobachtungen in Syrien am Libanon über Beirut 1901 bis 1904. p. 229–230.

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Peppler, W. Die täglichen unperiodischen Luftdruckschwankungen. (March, 1908.) p. 40–51.

Schulze, Paul. Ludwig Friedrich Kämtz. (March, April, May, 1908.) p. 51–53, 82–87, 106–111.

Klengel, Friedrich. Die Niederschlagsverhältnisse von Deutsch-Südwestafrika. III. Die aperiodischen Schwankungen des Neiderschlages. (March, April, 1908.) p. 54–57, 73–82.

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Malthan, Wilhelm. Die Wetterkunde in der Wetterdienst. (March, 1908.) p. 68–72.

Meissner, Otto. Der Mond und die Wolken. (April, 1908.) p. 91–92.

Knoch, Karl. Die Entwickelung unserer Kenntniss des Windschutzes bei der Aufstellung der Regenmesser. (May, 1908.) p. 97–102.

Joester, Karl. Die Föhnerscheinungen im Riesengebirge. (May, 1908.) p. 102–106.

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THE WEATHER OF THE MONTH.

By Mr. P. C. DAY, Assistant Chief, Division of Meteorological Records.

PRESSURE AND WINDS.

The distribution of mean atmospheric pressure for May, 1908, over the United States and Canada, is graphically shown on Chart VI, and the average values and departures from the normal are shown for each station in Tables I and III.

No wide variations occurred in the positions of the so-called more or less permanent areas of high and low pressure that normally occupy certain portions of the United States and Canada during May. The summer type of high pressure on the Pacific coast was somewhat more pronounced than usual, its influence extending farther inland and the pressure averaging higher than usual. The area of low pressure common to the season over the southwest, was considerably deeper and penetrated farther east and north than usual.

Pressure averaged slightly more than .05 inch above the normal over the Pacific coast districts from central California northward, and it was slightly above over the east Gulf States and the Florida Peninsula, and also over the Canadian Maritime Provinces. Over all interior districts of the United States and Canada the pressure average was below the normal, the maximum departure, about —.10 inch, occurring in the districts from the lower Missouri Valley to the Rocky Mountains.

Southerly winds prevailed over the districts east of the Rocky Mountains, except from the upper Lakes westward, where northerly winds predominated. Over the districts west of the mountains the winds were mostly westerly.

As compared with the normal the wind movement over most districts was in excess. Over the Pacific coast districts the wind movement was largely in excess of the normal, and at points in California and Idaho it exceeded that of any previous month in the history of the respective stations. There was a well-marked excess also from the Missouri Valley eastward over the Lake region and New England.

Severe local storms with distinctive tornado action occurred in Texas, Louisiana, Missouri, and Nebraska on the 12th and 13th, in Minnesota on the 24th, and Wyoming on the 31st, and severe local storms were reported from North Dakota, Oklahoma, and Tennessee on several dates.

TEMPERATURE.

Generally cool weather with mean temperature from 4° to 6° below the normal prevailed over nearly all districts west of the Rocky Mountains, the greatest deficiency occurring in the central Plateau district, where it was one of the coldest Mays in a long period of years.

The area with mean temperature below the normal extended eastward from the Rocky Mountains to the upper Mississippi Valley, and thence southwestward to western Texas.

Over the greater part of the Mississippi and Ohio valleys, and the Gulf and Atlantic States, the mean temperature was slightly above the normal, while over portions of New England and the lower Lake region it ranged from 2° to 3° above the average.

Maximum temperatures above 90° occurred over the Atlantic States from Maryland southward, over the Ohio Valley, Gulf States, and from Texas northward over the Great Plains to South Dakota, and generally over the lower elevations of New Mexico, Arizona, and interior California. Over the Rocky Mountains and Pacific coast districts the maximum temperatures were generally below 80° and below 70° on the immediate Pacific coast.

The minimum temperatures for the month over the districts east of the Rocky Mountains occurred generally from the 1st to 3d, and were unusually low over portions of the lower Mississippi Valley, where frosts occurred at a later date in spring than previously recorded in many years.

During the remainder of the month moderate temperatures prevailed over the above-mentioned districts. Over the districts west of the Rocky Mountains temperatures were low on numerous dates and frosts were frequent and severe.

PRECIPITATION.

The distribution of precipitation during May, 1908, is graphically shown on Chart IV by appropriate shading or by figures representing the actual amount of fall over districts, the topography of which is too varied to admit of approximately correct shading.

Heavy precipitation was the rule over nearly all districts from western Montana southeastward along the eastern slope of the Rocky Mountains into central Texas and eastward over the Mississippi and Ohio valleys, Lake region, Middle Atlantic States, and New England. Amounts from 8 to 10 inches occurred in portions of western and southern Montana and from southern Minnesota southward over the Great Plains to central Texas, also in the lower Mississippi Valley and in portions of Illinois and Indiana.

Precipitation in amounts from 4 to 6 inches occurred over most of the remaining districts east of the Rocky Mountains, except in portions of Alabama, Georgia, South Carolina, and Florida, where the monthly fall was somewhat less than 2 inches.

West of the Main Divide of the Rocky Mountains the precipitation was generally light, except in northern Utah, western Wyoming, southern Idaho, the western parts of Washington and Oregon, and in the mountains of northern California, where amounts from 3 to 5 inches occurred.

Precipitation was below the normal by small amounts generally over the Atlantic coast States from southern Virginia to Florida, over a small section from western Kansas and eastern Colorado southward over western Texas and eastern New Mexico, over the most of California, and in portions of eastern Washington and Oregon.

Over nearly all the remaining districts there was a general excess of precipitation, ranging from 2 to 8 inches. Over the greater portion of the central valleys the month was unusually wet, with rain at frequent intervals.

Thunderstorms were numerous and frequently of a destructive character, and the ground was generally well soaked with moisture.

SNOWFALL.

The area over which snowfall occurred and the monthly amounts are shown on Chart VII.

Light snows occurred during the first part of the month over the Appalachian Mountain districts from West Virginia northward into New England, and over the Lake region, becoming heavy in portions of western New York and western Pennsylvania. Local snows occurred over the upper Mississippi and Missouri valleys, and generally over the mountain and Plateau regions of the West.

Snow was heavy over the eastern slopes of the Rocky Mountains from central Colorado to southern and western Montana, the depths ranging, according to elevation, from 10 to more than 40 inches. Heavy snows fell in the mountains of California and local heavy falls were reported from the mountain districts of Oregon, Idaho, Utah, Arizona, and New Mexico.

HUMIDITY AND SUNSHINE.

The relative humidity was above the normal over practically all portions of the United States, the only exceptions being portions of the Florida Peninsula, the southern slope and south Pacific coast districts, where there was a slight deficiency. Over the Ohio, Mississippi, and Missouri valley districts the excess ranged from 4 to 10 per cent.

Much cloudy weather prevailed, especially over the more northern districts, where the percentage of sunshine averaged generally less than 40 per cent of the possible, reaching a minimum of less than 20 per cent over portions of Washington. Much cloudy weather prevailed also over the central mountain and Plateau districts and in the Ohio and Mississippi valleys.

The amount of sunshine was generally above the normal from New Mexico westward over Arizona to southern and central California, and there was a slight excess over the Florida Peninsula and portions of the Gulf States.

WEATHER IN ALASKA.

Over the coast districts from Sitka to the Alaskan Peninsula, including the Cook Inlet district, the temperatures were moderate, the night temperatures falling to the freezing point only on a few dates near the first of the month. Precipitation ranged from 3 to 8 inches and much clear, pleasant weather prevailed.

Over the west coast districts the night temperatures continued near the freezing point thruout most of the month, the weather was mostly cloudy, but precipitation was light. At Nome the ice broke loose from the shore on the 20th and by the end of the month Bering Sea was practically clear of ice and whalers were arriving.

Over the Yukon Valley districts the night temperatures were generally above freezing after the middle of the month, the precipitation was light, less than 1 inch, and only traces of snow occurred. The ice in the Tanana River, at Fairbank, broke up about the 3d, and at Rampart, on the Yukon, it broke about the 15th, and the first steamboat down the river past that point on the 21st.

Average temperatures and departures from the normal.

Districts.	Number of stations.	Average temperatures for the current month.	Departures for the current month.	Accumulated departures since January 1.	Average departures since January 1.
		°	°	°	°
New England	12	56.3	+ 1.5	+ 1.7	+ 0.3
Middle Atlantic	16	62.8	+ 1.1	+ 6.0	+ 1.2
South Atlantic	10	71.1	+ 1.2	+ 8.5	+ 1.7
Florida Peninsula*	8	76.2	+ 1.0	+ 8.1	+ 1.6
East Gulf	11	72.7	+ 0.4	+ 8.4	+ 1.7
West Gulf	10	73.0	+ 0.4	+13.0	+ 2.6
Ohio Valley and Tennessee	13	66.3	+ 1.1	+ 8.4	+ 1.7
Lower Lake	10	58.5	+ 1.3	+ 2.2	+ 0.4
Upper Lake	12	53.3	+ 1.1	+ 9.3	+ 1.9
North Dakota*	9	51.7	− 2.0	+21.1	+ 4.2
Upper Mississippi Valley	15	61.6	− 0.3	+13.2	+ 2.6
Missouri Valley	12	60.6	− 1.3	+20.6	+ 4.1
Northern Slope	9	50.4	− 2.6	+12.4	+ 2.5
Middle Slope	6	61.6	− 1.3	+17.7	+ 3.5
Southern Slope*	7	69.0	− 0.8	+11.8	+ 2.4
Southern Plateau*	12	60.4	− 4.2	+ 1.5	+ 0.3
Middle Plateau*	10	49.4	− 5.6	+ 1.4	+ 0.3
Northern Plateau*	12	51.0	− 4.1	+ 5.1	+ 1.0
North Pacific	7	50.3	− 2.9	+ 0.2	0.0
Middle Pacific	8	56.8	− 2.8	+ 0.5	+ 0.1
South Pacific	4	59.0	− 2.6	+ 3.6	+ 0.7

* Regular Weather Bureau and selected cooperative stations.

In Canada.—Director R. F. Stupart says:

The mean temperature of May was supernormal thruout Canada, except in the southern and western portions of British Columbia, where the average was not reached. Departures were, however, nowhere excessive, amounting to but a few degrees.

The precipitation during May was in excess of the normal over the greater portion of Canada, but a fairly pronounced deficiency occurred over a large part of Saskatchewan and small deficiencies more locally in British Columbia and in parts of Ontario, especially near the shores of Lakes Erie and Huron. Over most of Ontario and in western Quebec the rainfall was nearly double the average amount, while farther east in the lower St. Lawrence Valley and in the Maritime Provinces the average was exceeded by smaller amounts.

Average precipitation and departures from the normal.

Districts.	Number of stations.	Average.		Departure.	
		Current month.	Percentage of normal.	Current month.	Accumulated since Jan. 1.
		Inches.		Inches.	Inches.
New England	12	4.13	124	+0.8	−1.0
Middle Atlantic	16	5.06	142	+1.5	+0.3
South Atlantic	10	3.32	87	−0.5	−1.8
Florida Peninsula*	8	2.83	72	−1.1	−4.5
East Gulf	11	4.67	135	+1.2	+1.6
West Gulf	10	7.46	179	+3.3	+3.2
Ohio Valley and Tennessee	13	4.30	130	+1.0	+1.7
Lower Lake	10	3.59	113	+0.4	+2.2
Upper Lake	12	4.37	130	+1.0	+1.9
North Dakota*	9	2.92	121	+0.5	+1.0
Upper Mississippi Valley	15	7.06	170	+2.9	+3.0
Missouri Valley	12	5.46	128	+1.2	+0.9
Northern Slope	9	4.50	196	+2.2	+1.1
Middle Slope	6	4.94	129	+1.1	−0.1
Southern Slope*	7	6.16	156	+2.2	+2.9
Southern Plateau*	12	0.60	100	0.0	+0.2
Middle Plateau*	10	1.75	152	+0.6	−0.9
Northern Plateau*	12	2.21	129	+0.5	−1.9
North Pacific	7	2.86	112	+0.3	−1.5
Middle Pacific	8	1.09	92	−0.1	−3.6
South Pacific	4	0.31	51	−0.3	−1.2

* Regular Weather Bureau and selected cooperative stations.

Maximum wind velocities.

Stations.	Date.	Velocity.	Direction.	Stations.	Date.	Velocity.	Direction.
Bismarck, N. Dak	20	56	ne.	Mount Tamalpais, Cal.	22	54	nw.
Block Island, R. I	7	54	e.	Do	24	52	nw.
Do	30	50	s.	Do	28	58	nw.
Canton, N. Y	1	50	w.	Do	29	74	nw.
Do	12	55	sw.	Do	30	72	nw.
Cape Henry, Va	30	58	n.	Mount Weather, Va	1	70	nw.
Chicago, Ill	11	50	sw.	Nantucket, Mass	3	51	w.
Do	28	68	w.	New York, N. Y	2	50	nw.
Columbia, Mo	28	52	sw.	North Head, Wash	1	66	se.
Columbus, Ohio	1	52	nw.	Do	6	60	se.
Do	2	58	w.	Oklahoma, Okla	13	62	sw.
Concordia, Kans	28	52	w.	Pittsburg, Pa	2	51	w.
Detroit, Mich	11	54	sw.	Point Reyes Light, Cal.	2	65	nw.
Devils Lake, N. Dak	20	54	ne.	Do	3	58	nw.
Dodge, Kans	11	52	nw.	Do	8	67	nw.
Duluth, Minn	20	51	ne.	Do	9	78	nw.
Eastport, Me	1	54	e.	Do	10	68	nw.
Do	8	50	ne.	Do	11	96	nw.
El Paso, Tex	3	60	w.	Do	12	92	nw.
Do	10	52	w.	Do	13	62	nw.
Do	22	51	sw.	Do	19	60	nw.
Flagstaff, Ariz	8	56	sw.	Do	20	68	nw.
Hannibal, Mo	11	50	sw.	Do	21	78	nw.
Hatteras, N. C	29	54	nw.	Do	22	64	nw.
Do	30	52	w.	Do	24	76	nw.
Kansas City, Mo	28	52	nw.	Do	25	92	nw.
Little Rock, Ark	13	54	sw.	Do	26	50	nw.
Madison, Wis	7	54	n.	Do	28	64	nw.
Memphis, Tenn	4	57	sw.	Do	29	88	nw.
Minneapolis, Minn	20	53	se.	Do	30	76	nw.
Modena, Utah	2	52	sw.	Do	31	54	nw.
Do	7	50	sw.	Richmond, Va	2	52	sw.
Do	19	60	w.	Sand Key, Fla	7	50	sw.
Do	30	56	sw.	Shreveport, La	11	52	se.
Mount Tamalpais, Cal.	1	64	nw.	Sioux City, Iowa	16	60	ne.
Do	2	65	nw.	Southeast Farallon, Cal.	11	50	nw.
Do	3	66	nw.	Do	12	50	nw.
Do	7	50	nw.	Do	25	51	nw.
Do	9	50	nw.	Do	29	58	nw.
Do	11	62	nw.	Do	30	53	nw.
Do	12	56	nw.	Tatoosh Island, Wash.	7	50	s.
Do	13	54	nw.	Tonopah, Nev	25	52	nw.
Do	19	51	nw.	Valentine, Nebr	26	52	nw.
Do	20	76	nw.	Wichita, Kans	11	56	sw.
Do	21	61	nw.	Williston, N. Dak	29	58	n.

Average relative humidity and departures from the normal.

Districts.	Average.	Departure from the normal.	Districts.	Average.	Departure from the normal.
	%			%	
New England	78	0	Missouri Valley	69	+ 4
Middle Atlantic	76	+ 4	Northern Slope	69	+11
South Atlantic	75	+ 1	Middle Slope	62	+ 1
Florida Peninsula	74	— 2	Southern Slope	52	— 4
East Gulf	75	+ 4	Southern Plateau	35	+ 3
West Gulf	77	+ 2	Middle Plateau	51	+ 5
Ohio Valley and Tennessee	74	+ 6	Northern Plateau	57	+ 1
Lower Lake	77	+ 6	North Pacific	79	+ 3
Upper Lake	76	+ 4	Middle Pacific	67	+ 1
North Dakota	68	+ 6	South Pacific	67	— 2
Upper Mississippi Valley	73	+ 3			

Average cloudiness and departures from the normal.

Districts.	Average.	Departure from the normal.	Districts.	Average.	Departure from the normal.
New England	5.9	+ 0.4	Missouri Valley	5.2	— 0.2
Middle Atlantic	6.0	+ 0.8	Northern Slope	6.0	+ 0.6
South Atlantic	4.4	0.0	Middle Slope	4.8	0.0
Florida Peninsula	3.7	— 0.8	Southern Slope	3.8	— 0.7
East Gulf	4.7	+ 0.4	Southern Plateau	2.3	+ 0.1
West Gulf	4.7	— 0.2	Middle Plateau	4.7	+ 0.6
Ohio Valley and Tennessee	5.8	+ 0.7	Northern Plateau	6.1	+ 0.5
Lower Lake	5.9	+ 0.7	North Pacific	7.5	+ 1.6
Upper Lake	6.4	+ 0.9	Middle Pacific	3.1	— 1.1
North Dakota	5.6	+ 0.3	South Pacific	2.6	— 1.6
Upper Mississippi Valley	6.0	+ 0.8			

CLIMATOLOGICAL SUMMARY.

By Mr. JAMES BERRY, Chief of the Climatological Division.

TEMPERATURE AND PRECIPITATION BY SECTIONS, MAY, 1908.

In the following table are given, for the various sections of the Climatological Service of the Weather Bureau, the average temperature and rainfall, the stations reporting the highest and lowest temperatures with dates of occurrence, the stations reporting greatest and least monthly precipitation, and other data, as indicated by the several headings.

The mean temperatures for each section, the highest and lowest temperatures, the average precipitation, and the greatest and least monthly amounts are found by using all trustworthy records available.

The mean departures from normal temperature and precipitation are based only on records from stations that have ten or more years of observation. Of course the number of such records is smaller than the total number of stations.

Section.	Temperature—in degrees Fahrenheit.							Precipitation—in inches and hundredths.					
	Section average.	Departure from the normal.	Monthly extremes.					Section average.	Departure from the normal.	Greatest monthly.		Least monthly.	
			Station.	Highest.	Date.	Station.	Lowest.	Date.			Station.	Amount.	Station.	Amount.
Alabama	71.4	0.0	Flomation	98	3 d't's	Cullman	30	1	5.34	+ 1.96	Pushmataha	9.22	Ozark	1.74
			Lucy	98	28	Valley Head	30	15						
Arizona	65.1	— 4.4	Gilabend	105	30	Williams	21	17	0.35	— 0.01	Williams	2.60	8 stations	0.00
			Mohawk Summit	105	18, 28									
Arkansas	70.0	+ 0.3	Brinkley	96	23	Dutton, Pond	30	8	7.05	+ 2.00	Lewisville	12.54	Calico Rock	1.76
California	58.0	— 3.5	Mecca	103	29	Tamarack	3	1	1.63	+ 0.17	La Porte	9.16	12 stations	0.00
Colorado	49.1	— 2.9	Las Animas	97	19	Corona	4	5	2.19	+ 0.24	Corona	6.53	Manassa	0.26
Florida	76.1	+ 0.1	Huntington	102	29	Carrabelle	40	1	2.74	— 1.12	Miami	8.53	Manatee	0.14
			Orange City	102	29	Johnstown	40	28						
Georgia	72.1	+ 0.1	Blakely, Eastman	101	28	Rome	34	1	2.67	— 0.78	Newnan	5.63	Americus	0.45
Hawaii	71.5†		Kihei, Maui	89	11 d't's	Humuula, Hawaii	35	2, 20	4.21‡		Olaa, Hawaii	17.83	4 stations	0.00
						Mackay	20	4						
Idaho	48.8	— 3.2	Orifino	92	6	Standrod	20	10	2.33	+ 0.63	Driggs	4.46	Garnet	0.63
Illinois	63.3	+ 0.6	Golconda	95	24	Lanark	23	3	7.75	+ 3.61	Windsor	13.26	Grafton	4.20
			Mount Vernon	95	26									
Indiana	64.0	+ 1.4	Mount Vernon	98	21	Veedersburg	23	2	6.28	+ 2.06	Farmersburg	10.09	Salamonia	3.66
Iowa	59.4	— 0.7	Fort Dodge	93	16, 20	Washta	13	2	8.34	+ 3.84	Fort Madison	14.33	Belle Plaine	4.33
Kansas	63.8	— 0.2	Lakin	102	19	Saint Francis	25	1	5.56	+ 1.16	Lebo	11.21	Hugoton	0.03
Kentucky	66.7	+ 0.6	Maysville	96	29	Greensburg	28	1	4.34	+ 0.50	Mount Sterling	7.40	Beaverdam	2.46
Louisiana	74.2	+ 0.4	Melville	99	27, 31	Robeline	37	1	7.28	+ 3.76	Amite	16.55	Burrwood	0.23
Maryland and Delaware	63.6	+ 0.9	Cambridge, Md.	95	28	Deer Park, Md.	28	1	6.23	+ 2.59	Bachmans Valley, Md	15.32	Solomons, Md.	1.06
						Oakland, Md.	28	18						
Michigan	55.4	+ 1.7	Adrian	97	27	East Tawas	18	2	4.89	+ 1.76	Wasepi	8.27	West Branch	1.46
Minnesota	53.9	— 1.1	Morris	95	10	Detroit	16	2	6.28	+ 2.91	Winnebago	11.70	Red Lake	3.70
						Hallock	16	2, 3						
Mississippi	71.9	0.0	Shoccoe	98	28	Lake Como	36	1	6.38	+ 2.37	Shoccoe	11.32	Pontotoc	2.96
Missouri	66.1	+ 0.8	Warsaw	96	20	Sublett	24	22	6.92	+ 1.85	Unionville	17.07	Caruthersville	2.82
						Unionville	24	28						
Montana	50.0	— 1.3	2 stations	89	7, 9	Springbrook	12	1	5.00	+ 2.99	Red Lodge	11.90	Jordan	0.80
Nebraska	57.1	— 2.2	Holdredge	98	19, 20	Anoka	14	2	4.98	+ 1.20	Pawnee City	14.61	Benkelman	1.71
			Seward	98	20									
Nevada	49.9	— 4.6	Las Vegas	99	25, 26	Cherry Creek	7	10	1.01	— 0.03	Lewers Ranch	2.80	Mina	0.00
New England*	57.2	+ 2.0	Franklin, N. H.	92	26	St. Johnsbury, Vt.	21	2	4.70	+ 1.03	Southington, Conn.	7.40	Nantucket, Mass.	1.27
			Nashua, N. H.	92	26									
New Jersey	61.6	+ 0.8	Browns Mills	95	26, 27	Layton	29	5	7.10	+ 3.36	Bergen Point	9.99	Cape May	4.39
New Mexico	57.5	— 3.8	Carlsbad	101	21	Rociada, Springer	13	5	0.66	— 0.22	Monument	3.70	2 stations	0.00
New York	58.2	+ 1.7	Elba	93	25	Franklinville	19	4	5.07	+ 1.62	Salisbury Mills	10.05	Romulus	1.76
			Elmira	93	28									
North Carolina	67.5	+ 0.1	Kinston	96	15	Sapphire	28	1	3.86	— 0.45	Newbern	11.53	Ramseur	1.31
			Lumberton	96	31									
North Dakota	50.8	— 2.1	3 stations	88	8, 10	Mayville	9	2	2.97	+ 0.60	Buford	5.35	New England	0.56
Ohio	62.8	+ 1.4	Philo (2)	96	28	Bucyrus	25	3	4.72	+ 1.22	Milfordton	9.13	Willoughby	1.74
			Waverly	96	29	Garrettsville	25	15						
Oklahoma	67.8	— 0.6	Arapaho	100	20	Beaver	28	7	8.45	+ 3.52	Healdton	15.45	Kenton	0.38
Oregon	50.9	— 3.8	Umatilla	94	13	Christmas Lake	8	13	3.12	+ 0.65	Bull Run	8.01	Heisler	0.15
Pennsylvania	61.2	+ 1.4	Irwin	96	3 d't's	Pocono Lake	22	3	6.28	+ 2.17	Gettysburg	10.95	Kennett Square	3.19
Porto Rico	76.9		Juana Diaz	96	5	Aibonito	52	14	7.10		La Carmelita (b)	18.67	Comerio Falls	2.20
South Carolina	71.8	+ 0.9	9 stations	96	5 d't's	4 stations	36	1	2.92	— 0.37	Beaufort	7.06	Greenwood	0.70
South Dakota	54.8	— 1.8	Ottumwa	98	29	Frederick	15	2	4.65	+ 1.85	Mitchell	9.53	Clifton	1.52
Tennessee	68.6	+ 1.1	Jackson	97	29	Rugby	26	1	3.76	— 0.14	La Fayette	7.88	Charleston	1.67
Texas	73.5	+ 0.2	Fort McIntosh	105	13	Piemons	28	7	5.69	+ 3.12	Temple	11.70	Marfa	0.00
Utah	50.7	— 5.2	St. George	90	26	Pinto	11	9	2.35	+ 1.30	Alpine	6.99	Emery	0.20
			Hite	90	30									
Virginia	64.4	0.0	Arvonia	95	13	Burkes Garden	28	1	4.70	+ 0.67	Dale Enterprise	8.24	Warsaw	2.97
			Lincoln	95	27									
Washington	52.8	— 2.7	Hatton	95	6	Lake Kachess	23	14	2.39	+ 0.04	Quinault	8.22	Wahluke	0.02
West Virginia	63.4	+ 0.6	Cairo	96	29	3 stations	28	1	6.19	+ 2.14	Burlington	11.45	Valley Fork	2.73
Wisconsin	56.0	+ 0.2	Dodgeville	90	17	Koepenick	18	3	5.41	+ 1.54	Mauston	8.95	Rhinelander	2.44
			Downing	90	20	Long Lake	18	4						
Wyoming	46.7	— 2.3	Pine Bluff	87	19	Dubois	10	21	4.54	+ 3.08	Blue Cap	9.89	Eden	0.67
						Kirwin	10	21						

* Maine, New Hampshire, Vermont, Massachusetts, Rhode Island, and Connecticut. † 53 stations, with an average elevation of 724 feet. ‡ 146 stations.

TABLE I.—*Climatological data for U. S. Weather Bureau stations, May, 1908.*

Stations.	Elevation of instruments.			Pressure, in inches.			Temperature of the air, in degrees Fahrenheit.										Mean wet thermometer.	Mean temperature of the dew-point.	Mean relative humidity, per cent.	Precipitation, in inches.			Wind.					Clear days.	Partly cloudy days.	Cloudy days.	Average cloudiness during daylight, tenths.	Total snowfall.
	Barometer above sea level, feet.	Thermometers above ground.	Anemometer above ground.	Actual, reduced to mean of 24 hours.	Sea level, reduced to mean of 24 hrs.	Departure from normal.	Mean max. + mean min. ÷ 2.	Departure from normal.	Maximum.	Date.	Mean maximum.	Minimum.	Date.	Mean minimum.	Greatest daily range.					Total.	Departure from normal.	Days with .01, or more.	Total movement, miles.	Prevailing direction.	Maximum velocity. Miles per hour.	Maximum velocity. Direction.	Maximum velocity. Date.					
New England.							**56.3**	**+ 1.5**											**78**	**4.13**	**+ 0.8**									**5.9**	
Eastport	76	69	85	29.86	29.95	— .01	48.9	+ 2.0	76	24	56	36	2	42	33		45	42	82	2.58	— 1.2	12	7,899	s.	54	e.	1	5	13	13	6.7	
Greenville	....	....	....	28.79	29.95	.....	50.4	.....	77	26	62	25	4	39	44		....	....	....	5.50	.....	14	.....	se.	....	....	....	....	....	....	....	
Portland, Me.	103	81	117	29.83	29.95	— .02	54.3	+ 0.8	87	27	62	35	2	46	38		49	44	74	4.76	+ 1.1	15	6,930	s.	36	se.	1	7	8	16	6.2	
Concord	288	70	79	29.62	29.93	— .05	57.2	+ 1.5	89	26	68	35	2	46	41		....	....	....	4.25	+ 1.0	13	4,626	nw.	33	w.	12	15	8	8	4.3	T.
Burlington	404	12	47	29.48	29.92	— .05	57.2	+ 0.3	83	28	67	31	3	48	32		....	....	....	3.47	+ 0.6	17	8,427	s.	47	s.	1	5	15	11	6.3	2.8
Northfield	876	16	70	29.00	29.94	— .03	55.2	+ 1.7	87	26	67	29	5	44	40		53	50	81	3.73	+ 0.9	14	6,684	s.	38	nw.	12	4	14	13	6.9	1.0
Boston	125	115	188	29.82	29.96	— .02	59.0	+ 2.4	88	27	67	39	3	51	37		54	50	76	3.78	+ 0.3	10	8,110	e.	36	se.	30	9	11	11	5.9	
Nantucket	12	14	90	29.95	29.96	— .03	54.0	+ 1.0	73	13	60	40	6	47	27		51	50	90	1.27	— 1.4	10	12,997	sw.	51	w.	3	8	12	11	6.0	
Block Island	26	11	46	29.93	29.96	— .03	54.2	+ 1.3	73	13	60	41	3	48	23		51	49	86	4.76	+ 1.0	11	12,817	sw.	54	e.	7	9	16	6	5.0	
Narragansett	....	9	....	....	....	....	55.0	+ 0.3	82	13	62	38	4	48	32		....	....	....	4.19	....	9	....	sw.	....	....	....	16	2	13	....	
Providence	160	87	67	29.79	29.96	— .02	59.2	+ 0.7	88	27	69	37	3	50	39		53	48	71	4.18	+ 0.7	12	5,441	w.	34	se.	30	13	7	11	5.6	
Hartford	159	122	132	29.77	29.94	— .04	61.1	+ 3.6	87	27	70	38	3	52	38		54	50	74	6.52	+ 3.0	12	6,164	s.	29	w.	1	7	13	11	6.5	
New Haven	106	116	155	29.83	29.95	— .05	60.2	+ 2.6	86	27	69	38	3	52	37		54	49	72	6.16	+ 2.5	13	7,627	s.	35	w.	1	11	10	10	5.6	T.
Mid. Atlantic States.							**62.8**	**+ 1.1**											**76**	**5.06**	**+ 1.5**									**6.0**	
Albany	97	102	115	29.83	29.93	— .04	61.1	+ 2.2	86	26	70	38	5	52	37		54	49	68	4.26	+ 1.3	14	6,064	s.	41	nw.	29	6	14	11	6.1	
Binghamton	871	78	90	29.00	29.92	— .05	58.6	+ 1.6	87	28	68	31	5	50	39		....	....	....	3.95	+ 0.9	19	5,149	se.	28	s.	19	7	7	17	6.8	0.1
New York	314	108	350	29.61	29.94	— .05	61.3	+ 2.0	86	27	69	40	3	54	33		55	51	74	9.10	+ 5.9	12	9,353	ne.	50	nw.	2	7	10	14	6.3	
Harrisburg	374	94	104	29.55	29.95	— .03	62.6	+ 0.9	88	28	70	39	1	55	29		56	52	74	3.48	— 0.2	15	6,124	e.	34	nw.	2	9	7	15	6.5	
Philadelphia	117	116	184	29.83	29.96	— .03	63.6	+ 1.4	89	28	72	42	1	55	30		57	53	74	6.85	+ 3.6	14	7,788	ne.	31	nw.	10	7	11	13	6.1	
Scranton	805	111	119	29.68	29.94	— .04	61.1	+ 2.3	91	28	70	36	1	52	36		55	52	76	4.02	+ 0.6	15	6,022	sw.	42	w.	2	8	8	15	6.1	T.
Atlantic City	52	37	48	29.91	29.96	— .02	58.5	+ 1.0	85	13	64	42	1	53	27		55	52	81	5.56	+ 2.6	14	6,626	sw.	30	se.	7	6	10	15	6.7	
Cape May	17	48	52	29.96	29.98	— .01	59.8	+ 1.2	82	13	65	42	1	54	28		56	....	....	4.40	+ 1.4	15	6,788	s.	30	w.	1	5	18	8	6.1	
Baltimore	123	100	113	29.80	29.93	— .06	65.1	+ 0.9	89	14	73	40	1	57	36		59	56	75	4.04	+ 0.5	14	5,578	sw.	26	sw.	2	4	8	19	7.3	
Washington	112	59	76	29.82	29.94	— .06	65.3	+ 1.1	92	28	74	39	1	56	40		59	55	74	6.10	+ 2.3	13	5,135	ne.	33	nw.	10	7	17	7	5.5	
Cape Henry	18	9	58	29.94	29.96	— .04	65.6	+ 1.4	87	12	73	45	1	58	27		....	....	....	4.64	+ 0.6	11	9,854	sw.	58	n.	30	12	9	10	4.9	T.
Lynchburg	681	83	88	29.23	29.97	— .03	65.6	— 0.3	90	27	75	40	1	56	33		60	56	75	3.86	— 0.1	12	2,840	sw.	24	nw.	10	12	10	9	5.4	
Mount Weather	1,725	10	54	28.14	29.93	— .07	59.8	+ 0.3	82	14	67	30	1	53	26		54	51	79	5.86	+ 2.1	17	9,482	nw.	70	nw.	1	6	10	15	6.5	T.
Norfolk	91	102	111	29.87	29.97	— .03	67.6	+ 1.2	90	13	76	42	1	59	30		61	58	76	3.99	— 0.1	12	7,169	s.	40	nw.	30	10	11	10	5.6	
Richmond	144	145	153	29.81	29.96	— .03	67.2	— 0.1	90	27	77	40	1	58	37		....	....	....	6.71	+ 2.9	14	6,144	s.	52	sw.	2	12	12	7	4.8	
Wytheville	2,293	40	47	27.62	29.93	— .04	61.6	+ 0.2	84	27	72	35	1	51	39		56	54	84	4.10	+ 0.2	18	3,941	w.	30	w.	2	12	13	6	4.6	
S. Atlantic States.							**71.1**	**+ 1.2**											**75**	**3.32**	**— 0.5**									**4.4**	
Asheville	2,255	53	75	27.66	29.96	— .03	63.8	+ 1.2	85	28	74	35	1	53	35		58	56	81	3.06	— 0.7	11	4,731	se.	36	nw.	10	6	17	8	5.7	
Charlotte	773	68	76	29.15	29.98	— .01	68.8	+ 0.4	89	28	79	37	1	58	34		60	55	66	2.20	— 1.7	8	4,999	sw.	29	sw.	2	14	12	5	4.5	
Hatteras	11	12	47	29.96	29.97	— .04	69.4	+ 2.3	81	27	74	48	1	65	18		65	62	82	7.38	+ 3.2	10	10,560	sw.	54	nw.	29	21	6	4	3.6	
Manteo	....	....	....	....	....	....	67.3	.....	87	30	76	43	2	59	.....		....	....	....	7.48	+ 3.4	9	.....	sw.	....	....	....	19	5	7	....	
Raleigh	376	71	79	29.57	29.96	— .03	69.0	+ 0.9	90	31	80	38	1	59	36		61	56	69	2.03	— 2.9	9	4,600	sw.	27	sw.	2	10	13	8	5.3	
Wilmington	78	81	91	29.90	29.98	— .03	70.8	+ 1.7	89	30	79	42	1	62	25		64	61	77	2.80	— 1.2	9	6,237	sw.	27	sw.	7	10	16	5	4.7	
Charleston	48	14	92	29.94	29.99	— .02	74.0	+ 1.6	93	29	82	46	1	66	30		68	66	81	2.01	— 1.5	10	7,472	s.	26	nw.	19	11	17	3	4.4	
Columbia, S. C.	351	41	57	29.60	29.97	— .03	72.5	+ 0.7	93	15	84	40	1	62	32		63	53	68	2.93	— 0.3	10	5,249	sw.	32	sw.	23	10	15	6	4.8	
Augusta	180	89	97	29.79	29.98	— .01	73.0	+ 0.8	94	28	84	42	1	62	33		65	62	73	0.91	— 2.3	8	4,668	w.	30	nw.	17	21	9	1	2.3	
Savannah	65	81	89	29.92	29.99	— .01	74.4	+ 1.9	92	16	84	46	1	65	31		66	63	74	2.65	— 0.4	11	5,499	sw.	34	n.	29	13	15	3	4.4	
Jacksonville	43	101	129	29.96	30.01	+ .01	75.2	+ 1.0	92	30	84	48	1	66	26		68	65	76	3.07	— 1.2	8	6,613	s.	38	sw.	30	18	10	3	3.8	
Florida Peninsula.							**78.2**	**+ 1.2**											**74**	**1.72**	**— 1.0**									**3.7**	
Jupiter	28	10	48	29.97	30.00	+ .02	77.0	+ 0.6	92	28	84	58	10	70	25		71	69	77	3.05	— 1.7	9	8,149	se.	38	sw.	6	10	18	3	4.7	
Key West	22	10	53	29.97	29.99	+ .02	80.4	+ 1.4	88	6	86	71	10	78	16		73	70	74	0.60	— 2.8	6	7,022	e.	42	sw.	7	16	14	1	3.6	
Sand Key	25	41	71	29.95	29.98	+ .01	79.0	.....	91	30	82	67	4	76	15		....	....	....	1.44	— 1.9	5	9,589	e.	50	sw.	7	18	8	5	3.4	
Tampa	35	79	96	29.97	30.00	+ .01	77.2	+ 1.7	93	22	87	54	2	68	30		69	65	71	1.81	— 1.1	5	5,884	w.	26	e.	4	17	13	1	3.2	
East Gulf States.							**72.7**	**+ 0.4**											**75**	**4.67**	**+ 1.2**									**4.7**	
Atlanta	1,174	190	216	28.77	29.99	.00	69.7	+ 0.2	90	28	79	39	1	61	28		63	60	76	2.95	— 0.1	9	7,196	nw.	48	nw.	29	10	9	12	5.7	
Macon	370	55	66	29.60	29.99	.00	73.8	+ 2.7	93	24	85	42	1	62	34		....	....	....	2.99	+ 0.1	11	3,422	nw.	24	w.	29	14	11	6	3.8	
Thomasville	273	8	58	29.71	30.00	+ .01	74.4	+ 0.4	97	28	87	41	1	62	35	66	62	71		3.91	— 0.1	5	3,652	sw.	26	sw.	30	23	6	2	2.3	
Pensacola	56	79	96	29.94	30.00	+ .01	74.2	— 0.6	88	28	81	48	1	68	22		....	....	....	2.42	— 0.3	6	7,439	sw.	38	se.	6	13	15	3	4.1	
Anniston	741	9	58	29.22	30.01	+ .02	69.6	+ 1.2	92	23	80	34	1	59	35		....	....	....	4.97	+ 1.9	13	3,784	se.	27	se.	5	8	8	15	6.4	
Birmingham	700	11	48	29.23	29.99	+ .01	70.8	— 0.8	91	23	80	38	1	61	33	64	61	75		6.60	+ 3.5	13	4,823	s.	29	se.	29	4	16	11	6.3	
Mobile	57	98	106	29.93	29.99	.00	74.4	+ 0.8	90	27	82	47	1	67	25	68	66	79		4.82	+ 0.8	5	6,007	se.	33	nw.	18	14	16	1	3.8	
Montgomery	223	100	112	29.74	29.99	.00	73.2	— 0.3	95	23	84	44	1	63	30	65	61	71		3.90	+ 0.1	7	4,530	w.	31	w.	29	11	11	9	5.3	
Meridian	375	84	93	29.58	29.96	+ .02	72.0	+ 0.9	93	28	83	40	1	62	35	65	61	73		6.73	+ 2.8	7	4,007	s.	34	w.	5	18	5	8	4.2	
Vicksburg	247	62	74	29.68	29.96	+ .01	71.8	— 1.1	89	31	80	46	1	64	26	65	62	76		7.35	+ 3.1	10	5,417	se.	37	nw.	29	15	5	11	4.8	
New Orleans	51	88	121	29.92	29.97	.00	75.9	+ 1.4	91	27	84	53	1	68	23	69	66	78		4.77	+ 0.9	9	7,409	se.	36	s.	5	8	18	5	4.9	
West Gulf States.							**73.0**	**+ 0.4**											**77**	**7.46**	**+ 3.3**									**4.7**	
Shreveport	249	77	84	29.64	29.91	— .04	73.0	+ 0.2	90	28	82	50	8	64	28	66	63	77		14.11	+10.0	12	6,388	se.	52	se.	11	8	16	7	5.1	
Bentonville	1,303	11	44	28.50	29.84	— .09	67.0	+ 0.6	87	20	77	38	9	57	33	....	....	....	....	7.72	+ 2.5	11	4,722	s.	24	s.	11	14	12	5	4.3	
Fort Smith	457	79	94	29.37	29.85	— .08	69.8	+ 0.1	89	19	79	43	8	60	28	64	61	77		9.79	+ 4.9	11	6,271	e.	36	nw.	22	11	14	6	4.9	
Little Rock	357	139	147	29.53	29.90	— .05	70.4	0.0	88	19	79	44	1	62	28	64	61	76		4.59	— 0.5	9	7,400	se.	54	sw.	13	7	17	7	5.6	
Corpus Christi	20	48	53	29.84	29.85	— .05	77.6	+ 1.1	91	5	82	53	1	73	21	72	69	80		2.34	— 0.4	3	11,540	se.	37	se.	23	10	15	6	4.5	
Fort Worth	670	106	114	29.14	29.84	— .07	72.8	— 0.4	90	19	82	46	7	64	29	....	....	....	....	10.69	+ 6.5	11	9,925	s.	48	n.	23	15	11	5	4.1	
Galveston	54	106	112	29.87	29.93	— .01	75.9	+ 0.5	87	5	80	56	7	72	14	71	69	84		3.40	+ 0.2	2	10,941	se.	44	e.	14	16	13	2	3.7	
Palestine	510	73	79	29.34	29.87	— .06	72.9	+ 0.4	89	30	81	45	1	64	30	67	64	79		7.86	+ 3.0	8	2,685	s.	9	s.	20	4	19	8	6.5	
San Antonio	701	80	91	29.11	29.82	— .08	76.2	+ 1.4	95	19	86	46	1	66	34	67	65	69		6.07	+ 3.1	5	5,858	se.	30	e.	30	13	13	5	4.3	
Taylor	583	55	63	29.26	29.87	— .04	74.2	— 0.1	91	19	84	44	1	64	32	....	....	....	....	8.03	+ 4.0	9	8,766	s.	42	ne.	29	15	11	5	3.8	
Ohio Val. and Tenn.							**66.3**	**+ 1.1**											**74**	**4.30**	**+ 1.0**									**5.8**	
Chattanooga	762	106	112	29.18	29.98	— .01	69.4	+ 0.8	91	23	79	37	1	60	33	62	57	69		1.94	— 1.7	12	4,423	sw.	28	nw.	5	9	10	12	5.8	
Knoxville	1,004	93	100	28.92	29.96	—.03	68.2	+ 1.7	90	23	78	36	1	59	32	61	57	74		2.15	— 1.6	13	3,740	sw.	25	w.	18	7	11	13	6.2	
Memphis	399	76	97	29.52	29.94	— .02	71.1	+ 0.4	91	24	78	48	8	64	24	66	63	78		3.21	— 1.1	11	6,986	s.	57	sw.	4	13	5	13	5.2	
Nashville	546	79	91	29.38	29.96	— .02	69.3	+ 0.5	91	24	79	36	1	60	29	62	58	72		2.80	— 0.7	13	4,625	sw.	35	nw.	5	9	8	14	5.8	
Lexington	989	75	102	28.88	29.93	— .06	64.8	+ 0.5	87	25	73	34	1	56	32	....	....	....	....	4.20	+ 0.7	14	7,434	sw.	40	w.	6	17	7	7	4.4	
Louisville	525	111	132	29.34	29.92	— .06	68.0	+ 1.3	92	28	77	36	1	59	26	60	56	70		4.26	+ 0.6	14	6,199	sw.	37	w.	1	7	16	8	5.8	
Evansville	431	72	82	29.42	29.89	— .08	67.2	+ 0.1	91	24	76	42	2	58	29	....	....	....	....	6.51	+ 3.1	11	6,104	s.	43	sw.	11	5	20	6	5.5	
Indianapolis	822	154	164	29.01	29.89	— .08	63.8	+ 0.5	87	25	72	34	2	56	25	58	54	75		5.19	+ 1.2	16	8,221	sw.	48	sw.	11	5	11	15	6.9	
Cincinnati	628	152	160	29.24	29.91	— .08	65.1	+ 1.0	93	25	75	35	1	57	28	59	54	69		5.84	+ 2.3	16	5,090	sw.	39	w.	25	3	19	9	6.2	
Columbus	824	173	224	29.04	29.91	— .07	64.0	+ 1.7	91	29	73	34	1	55	26	57	53	72		4.04	+ 0.3	16	8,906	sw.	58	w.	2	8	10	13	6.0	
Pittsburg	842	336	352	29.03	29.92	— .07	63.4	+ 0.8	89	25	74	33	1	55	27	57	53	74		3.84	+ 0.5	18	7,390	sw.	51	w.	2	6	12	13	6.2	0.1
Parkersburg	638	77	84	29.28	29.93	— .06	65.4	+ 2.1	91	28	75	37	1	56	35	59	56	76		3.54	+ 0.1	17	4,337	s.	31	nw.	2	10	9	12	5.6	
Elkins	1,940	41	50	27.93	29.95	— .05	61.4	+ 2.3	88	25	72	33	1	51	44	56	53	83		8.42	+ 4.4	21	2,787	w.	29	w.	2	8	11	12	6.1	T.
Lower Lake Region.							**58.5**	**+ 1.3**											**77**	**3.59**	**+ 0.4**									**5.9**	
Buffalo	767	178	206	29.08	29.91	— .06	56.2	+ 1.7	86	25	64	31	1	49	30	52	49	79		4.08	+ 1.0	19	10,122	sw.	49	sw.	12	8	12	11	5.9	0.3
Canton	448	10	71	29.42	29.90	.....	56.7	+ 0.5	85	28	66	32	5	47	34	....	....	....	....	6.45	+ 3.6	19	8,992	sw.	55	sw.	12	4	16	11	6.6	1.5
Oswego	333	76	91	29.54	29.91	— .06	56.2	+ 1.5	88	28	64	32	1	48	31	52	49	80		3.49	+ 0.6	19	7,833	s.	37	w.	1	9	8	14	6.1	T.
Rochester	523	81	102	29.36	29.92	— .05	58.8	+ 2.1	91	28	67	32	1	51	31	53	48	72		2.47	— 0.5	17	6,890	w.	45	w.	12	8	10	13	6.0	3.0
Syracuse	597	97	113	29.28	29.92	— .06	58.2	+ 0.9	87	28	67	31	1	50	32	....	....	....	....	3.49	+ 0.1	20	9,024	s.	42	w.	12	7	9	15	6.5	1.4
Erie	713	92	102	29.13	29.90	— .08	58.4	+ 1.1	88	28	66	33	2	51	27	53	48	71		3.22	— 0.2	18	8,013	w.	42	se.	7	11	12	8	5.2	T.
Cleveland	762	190	201	29.09	29.90	— .08	60.4	+ 1.9	88	28	68	36	2	52	28	54	50	71		2.38	— 0.8	22	9,768	se.	48	w.	2	10	10	11	5.7	0.1
Sandusky	629	62	70	29.21	29.89	— .09	60.4	+ 1.2	90	28	68	33	3	53	26	....	....	....	....	2.12	— 1.1	16	5,856	e.	39	nw.	28	10	6	15	5.7	T.
Toledo	628	207	246	29.21	29.89	— .08	60.6	+ 0.9	88	28	69	34	3	52	26	55	51	76		4.64	+ 1.4	19	10,190	sw.	49	w.	2	8	12	11	5.5	T.
Detroit	730	218	258	29.11	29.90	— .07	59.2	+ 1.3	85	28	68	31	2	50	26	56	54	87		3.57	+ 0.3	16	10,166	e.	54	sw.	11	8	9	14	6.1	T.
Upper Lake Region.							**53.3**	**+ 1.1**											**76**	**4.37**	**+ 1.0**									**6.4**	
Alpena	609	13	92	29.25	29.92	— .05	51.4	+ 1.9	83	26	60	27	4	42	33	47	43	78		4.84	+ 1.5	17	8,261	se.	36	se.	27	5	13	13	6.6	T.

TABLE I.—*Climatological data for U. S. Weather Bureau stations, May, 1908*—Continued.

Stations.	Elevation of instruments.			Pressure, in inches.			Temperature of the air, in degrees Fahrenheit.										Mean wet thermometer.	Mean temperature of the dew-point.	Mean relative humidity, per cent.	Precipitation, in inches.			Wind.				Clear days.	Partly cloudy days.	Cloudy days.	Average cloudiness during daylight, tenths.	Total snowfall.
	Barometer above sea level, feet.	Thermometers above ground.	Anemometer above ground.	Actual, reduced to mean of 24 hours.	Sea level, reduced to mean of 24 hrs.	Departure from normal.	Mean max. + mean min. ÷ 2.	Departure from normal.	Maximum.	Date.	Mean maximum.	Minimum.	Date.	Mean minimum.	Greatest daily range.					Total.	Departure from normal.	Days with .01, or more.	Total movement miles.	Prevailing direction.	Maximum velocity. Miles per hour.	Maximum velocity. Direction.	Maximum velocity. Date.					
Up. Lake Reg—Cont.																														
Escanaba	612	40	82	29.25	29.92	— .05	51.3	+ 1.3	75	26	59	26	1	43	27		46	42	75	3.01	— 0.4	15	7,564	s.	35	e.	14	5	8	18	6.9	0.2
Grand Haven	632	54	92	29.18	29.86	— .10	55.4	+ 0.6	83	25	64	32	2	47	32		52	49	80	4.20	+ 0.9	15	8,734	w.	48	nw.	2	6	15	10	6.3	T.
Grand Rapids	707	121	162	29.11	29.88	— .09	58.4	— 0.6	86	25	68	30	2	49	32		53	49	74	5.34	+ 2.0	16	8,608	e.	40	n.	2	4	12	15	7.1	T.
Houghton	668	66	74	29.19	29.92	— .05	50.4	+ 0.7	89	25	60	31	5	41	38		...	...	...	4.84	+ 1.6	15	6,413	e.	27	w.	23	9	11	11	5.6	0.3
Marquette	734	77	116	29.14	29.94	— .03	48.6	— 0.4	85	25	56	30	4	41	42		44	38	71	3.11	— 0.2	18	6,398	nw.	31	s.	21	4	16	11	6.4	1.2
Port Huron	638	70	120	29.20	29.89	— .08	56.6	+ 2.9	87	28	66	29	3	47	38		52	48	76	3.73	+ 0.5	14	8,029	ne.	38	nw.	2	9	9	13	6.3	T.
Sault Sainte Marie	614	40	61	29.24	29.94	— .01	50.8	+ 3.1	79	20	60	30	1	41	41		47	42	73	2.76	— 0.5	12	6,634	se.	37	nw.	2	6	7	18	7.2	
Chicago	823	140	310	28.99	29.88	— .08	58.7	+ 2.2	87	25	66	34	2	51	33		54	52	81	6.74	+ 3.4	14	11,344	w.	68	w.	28	8	11	12	6.2	
Milwaukee	681	122	139	29.16	29.90	— .06	54.3	+ 0.7	84	25	62	32	2	46	40		50	46	80	4.55	+ 1.1	15	8,243	ne.	45	n.	7	12	8	11	5.3	T.
Green Bay	617	49	86	29.20	29.86	— .09	55.8	+ 1.3	83	25	65	30	2	47	35		50	46	74	3.64	+ 0.1	17	9,324	ne.	48	ne.	7	4	8	19	7.3	0.4
Duluth	1,133	11	47	28.71	29.94	— .02	47.6	— 1.0	81	19	56	26	2	39	39		42	36	70	5.73	+ 2.3	13	11,764	ne.	51	ne.	20	8	10	13	6.0	T.
North Dakota.							51.1	— 3.2											68	2.64	+ 0.2									5.6	
Moorhead	940	8	57	28.90	29.92	— .02	53.0	— 1.8	80	17	64	21	2	42	42		48	43	73	4.16	+ 1.2	11	6,045	ne.	33	e.	14	10	8	13	5.8	T.
Bismarck	1,674	8	57	28.14	29.92	— .00	51.8	— 3.4	81	16	64	21	2	40	40		46	39	67	2.89	+ 0.4	8	8,522	e.	56	ne.	20	10	11	10	5.8	T.
Devils Lake	1,482	11	44	28.34	29.92	— .02	49.6	— 3.1	78	9	61	18	2	38	38		44	38	69	1.71	— 0.5	9	9,291	ne.	54	ne.	20	10	6	15	5.8	0.1
Williston	1,875	14	56	27.92	29.90	— .06	50.0	— 4.3	78	9	61	21	2	39	40		44	37	63	1.80	— 0.5	10	8,670	e.	58	n.	20	11	9	11	5.4	6.4
Upper Miss. Valley.							51.6	— 0.3											73	7.06	+ 2.9									6.0	
Minneapolis	.....	102	208	.....	.....	.....	56.2	.....	84	17	65	28	2	47	31		...	...	...	8.14	+ 4.2	15	10,096	n.	53	se.	20	7	10	14	6.4	T.
St. Paul	837	171	179	28.97	29.87	— .07	56.4	— 1.8	83	19	65	28	2	48	33		50	44	67	7.57	+ 4.0	15	7,193	n.	39	se.	20	8	10	13	6.0	T.
La Crosse	714	10	49	29.09	29.86	— .08	58.6	— 0.9	87	17	69	28	3	48	41		...	...	...	8.37	+ 4.6	14	4,244	s.	26	sw.	25	7	5	19	7.0	T.
Madison	974	70	78	28.83	29.87	— .09	57.2	— 0.4	82	17	66	31	2	49	33		52	49	76	5.38	+ 1.8	15	8,727	se.	54	n.	7	10	6	15	6.1	T.
Charles City	1,015	3	49	28.80	29.87	— .07	57.3	— 2.2	84	17	68	27	3	47	41		52	48	74	6.55	+ 1.6	14	6,178	se.	34	sw.	25	5	8	18	7.0	0.0
Davenport	606	71	79	29.20	29.86	— .09	61.2	— 0.3	87	17	70	30	2	52	31		55	51	73	5.13	+ 0.9	17	6,988	nw.	39	s.	28	7	10	14	6.4	T.
Des Moines	861	84	101	28.94	29.84	— .09	60.4	— 1.2	86	20	70	30	2	51	34		55	52	76	9.89	+ 5.3	18	7,403	se.	36	se.	10	7	11	13	6.2	0.0
Dubuque	698	100	117	29.14	29.88	— .07	59.7	— 1.1	85	17	69	30	2	50	37		53	48	68	5.82	+ 1.5	14	5,030	se.	31	n.	7	8	10	13	5.8	0.0
Keokuk	614	64	77	29.20	29.86	— .08	63.2	0.0	87	24	72	30	2	54	30		57	53	75	10.09	+ 5.8	16	6,210	se.	38	sw.	28	10	13	8	4.8	0.0
Cairo	356	87	93	29.53	29.90	— .06	69.0	+ 1.5	90	24	77	45	2	61	24		62	59	74	4.90	+ 1.1	15	6,664	s.	48	s.	11	7	10	14	6.1	
La Salle	536	56	64	29.30	29.87	— .09	61.6	+ 0.8	87	17	70	31	2	53	31		...	...	...	6.69	+ 2.8	17	7,318	w.	42	sw.	28	5	12	14	6.3	
Peoria	609	11	45	29.22	29.88	— .08	62.0	+ 0.3	87	24	71	31	2	53	32		57	54	77	7.76	+ 3.5	19	7,390	se.	42	w.	21	13	10	8	4.6	
Springfield, Ill	644	10	92	29.19	29.87	— .08	64.6	+ 1.1	88	24	73	34	2	56	28		57	53	72	7.27	+ 2.8	16	7,618	s.	44	w.	27	9	12	10	5.7	
Hannibal	534	75	109	29.27	29.84	— .10	64.4	0.0	87	24	74	33	2	55	30		...	...	...	4.60	— 0.4	17	7,899	sw.	50	sw.	11	4	12	15	6.5	0.0
St. Louis	567	208	217	29.26	29.86	— .09	66.9	+ 0.4	89	24	75	38	2	58	22		60	57	76	7.72	+ 3.5	15	8,321	s.	46	sw.	11	13	9	9	5.0	
Missouri Valley.							60.6	— 1.3											69	5.46	+ 1.2									5.2	
Columbia, Mo	784	11	84	29.03	29.85	— .09	65.4	+ 0.9	88	20	76	33	2	55	30		...	...	...	6.17	+ 1.3	15	6,669	s.	52	sw.	28	12	14	5	4.3	
Kansas City	963	116	181	28.81	29.83	— .09	64.3	— 0.2	90	20	73	36	2	52	25		58	53	71	5.09	0.0	12	10,613	s.	52	nw.	28	10	15	6	4.8	
Springfield, Mo	1,324	98	104	28.47	29.86	— .07	66.4	+ 1.8	87	20	76	41	8	57	26		60	57	77	4.66	— 0.9	15	8,672	se.	48	nw.	4	21	7	3	2.6	
Iola	984	11	50	28.79	29.82	— .10	66.3	+ 1.8	88	20	76	28	1	56	36		...	...	...	4.31	— 0.7	11	6,555	s.	36	se.	13	9	8	14	6.2	
Topeka	.....	85	89	.....	.....	.....	63.4	— 1.6	87	20	73	36	2	54	27		...	...	...	9.07	+ 4.2	15	7,712	s.	34	w.	21	16	5	10	4.5	
Lincoln	1,189	11	84	28.56	29.80	— .11	60.8	— 1.7	87	20	70	33	2	52	28	54	50	71	6.65	+ 2.2	16	7,324	se.	36	nw.	21	8	6	17	6.6	
Omaha	1,105	115	121	28.60	29.83	— .09	60.8	— 1.7	87	20	70	33	2	52	28	54	50	71	6.65	+ 2.2	16	7,824	se.	36	nw.	21	8	6	17	6.6	
Valentine	2,598	47	54	27.15	29.85	— .05	53.4	— 4.5	90	19	66	28	6	41	40	46	40	67	4.78	+ 1.4	11	9,325	e.	52	nw.	26	12	14	5	4.8	4.5
Sioux City	1,135	96	164	28.63	29.84	— .08	58.6	— 2.2	86	19	69	25	2	48	36		...	...	...	6.19	+ 1.8	14	10,700	se.	60	ne.	16	6	15	10	6.0	T.
Pierre	1,572	70	75	28.20	29.86	— .05	56.3	— 3.0	90	19	67	29	2	45	38	48	40	60	3.98	+ 1.8	9	8,815	se.	40	ne.	13	9	12	10	5.6	
Huron	1,306	56	67	28.49	29.88	— .04	54.9	— 2.4	87	19	67	24	2	43	40	49	42	66	5.47	+ 2.6	8	8,733	e.	42	se.	17	11	9	11	5.5	
Yankton	1,233	49	57	28.52	29.83	— .09	57.4	— 2.6	88	19	69	25	2	46	40		...	...	...	3.84	— 0.1	12	6,550	nw.	43	nw.	26	7	8	16	6.5	
Northern Slope.							50.4	— 2.6											69	4.50	+ 2.2									6.0	
Havre	2,505	11	44	27.22	29.82	— .08	55.2	+ 1.1	86	7	67	30	1	43	40	48	42	68	1.87	— 0.2	8	6,750	e.	37	w.	29	8	19	4	4.7	0.0
Miles City	2,371	26	48	27.34	29.88	— .03	54.6	— 2.1	80	8	66	26	22	44	39	47	42	70	5.58	+ 3.6	13	5,762	ne.	40	e.	31	7	15	9	5.7	22.0
Helena	4,110	8	56	25.69	29.87	— .06	49.0	— 2.6	82	7	58	34	17	40	38	42	37	68	6.19	+ 4.2	19	5,344	sw.	37	w.	29	7	6	18	7.1	0.0
Kalispell	2,962	8	34	26.83	29.88	.00	49.1	— 1.9	78	6	58	33	19	40	42	43	40	77	4.21	+ 2.2	19	3,361	w.	29	w.	7	5	9	17	7.0	0.0
Rapid City	3,234	46	50	26.49	29.89	— .01	50.6	— 3.6	77	15	61	28	2	40	41	46	40	71	5.46	+ 2.6	12	2,898	nw.	18	ne.	31	14	9	8	4.9	T.
Cheyenne	6,088	56	64	23.87	29.78	— .07	47.8	— 3.2	81	19	60	23	6	36	43	39	31	60	6.19	+ 3.8	14	8,520	nw.	42	w.	20	8	15	8	5.6	10.8
Lander	5,372	26	36	24.49	29.79	— .09	48.4	— 3.6	76	18	61	27	21	36	40	42	35	67	3.66	+ 0.8	12	3,272	nw.	32	s.	31	5	14	12	6.3	2.0
Sheridan	3,790	9	47	25.95	29.83	.....	50.2	.....	80	7	62	28	21	38	45	44	37	69	6.65	.....	15	6,884	nw.	46	se.	30	9	8	14	5.8	7.5
Yellowstone Park	6,200	11	48	23.74	29.82	— .09	43.3	— 4.1	68	6	53	26	21	33	39	36	31	71	3.38	+ 1.5	17	6,227	nw.	36	s.	18	4	6	21	7.8	7.8
North Platte	2,821	11	51	26.93	29.83	— .05	55.6	— 3.4	91	19	68	28	2	43	40	48	41	65	3.95	+ 0.9	13	6,956	se.	30	nw.	14	14	8	9	4.7	1.6
Middle Slope.							61.6	— 1.3											62	4.94	+ 1.1									4.6	
Denver	5,291	129	136	24.57	29.77	— .07	53.8	— 2.9	88	19	66	28	4	41	40	42	31	52	2.82	+ 0.3	10	6,410	n.	35	sw.	19	5	19	7	5.4	10.0
Leadville	10,248	7	....	.....	.....	.....	.....	.....	...	...	...	...	...	...	...	...	...	...	...	.....	.....	...	.....	...	...	...	...	...	...	...	...
Pueblo	4,685	80	86	25.12	29.73	— .10	57.9	— 1.6	90	31	72	31	6	43	47	43	27	41	0.97	— 0.7	5	6,802	se.	46	n.	4	20	7	4	3.1	T.
Concordia	1,398	42	50	28.35	29.81	— .10	61.8	— 1.9	91	19	73	33	2	51	34	55	50	70	6.51	+ 1.8	17	6,550	se.	52	w.	28	6	16	9	5.8	0.0
Dodge	2,509	44	54	27.19	29.75	— .12	64.0	+ 0.5	96	19	78	34	7	50	41	53	46	62	0.90	— 2.4	12	9,470	se.	52	nw.	11	17	9	5	4.0	0.0
Wichita	1,358	90	120	28.41	29.82	— .08	65.3	— 0.6	89	20	75	37	7	55	30	58	54	72	9.28	+ 4.3	14	9,361	s.	56	sw.	11	9	14	8	5.4	
Oklahoma	1,214	10	47	28.54	29.80	— .09	67.0	— 1.1	89	19	76	40	7	58	27	61	58	76	9.17	+ 3.4	12	13,787	s.	62	sw.	13	10	11	10	5.4	0.0
Southern Slope.							70.1	— 0.6											52	3.37	+ 1.0									3.3	
Abilene	1,738	45	54	28.02	29.79	— .08	72.4	+ 0.5	99	20	84	40	7	61	36	62	55	60	8.38	+ 4.7	11	7,614	s.	32	w.	23	11	15	5	4.6	
Amarillo	3,676	10	49	26.10	29.75	— .09	63.6	— 0.7	91	19	78	34	7	49	43	52	42	56	3.55	— 0.1	5	11,050	sw.	40	sw.	3	28	1	2	2.7	
Del Rio	944	8	57	28.83	29.79	— .06	78.2	+ 1.3	102	21	90	46	1	66	37	...	...	...	3.47	+ 0.5	5	7,248	se.	39	se.	22	14	14	3	3.9	
Roswell	3,578	9	57	26.20	29.77	— .05	66.1	— 3.3	93	19	83	36	6	49	49	49	34	40	0.07	— 1.1	4	5,497	sw.	32	w.	3	14	13	4	3.9	
Southern Plateau.							61.3	— 4.6											35	0.60	0.0									2.3	
El Paso	3,762	110	133	26.06	29.74	— .04	69.2	— 2.9	92	30	82	43	4	56	37	48	23	22	0.01	— 0.3	1	11,046	w.	60	w.	3	19	10	2	2.5	0.0
Santa Fe	7,013	33	39	23.18	29.71	— .10	51.0	— 5.7	76	31	64	28	4	38	34	39	24	37	2.10	+ 1.0	7	7,371	sw.	39	sw.	3	20	9	2	3.0	1.7
Flagstaff	6,907	8	57	23.24	29.76	— .02	45.3	— 5.4	71	29	60	22	3	39	42	36	28	58	1.43	+ 0.2	6	8,349	sw.	56	sw.	8	20	7	4	3.0	10.0
Phoenix	1,108	50	56	28.64	29.78	.00	71.5	— 3.3	97	29	87	48	13	56	38	50	26	23	0.03	0.0	2	4,317	e.	30	sw.	3	24	7	0	1.7	0.0
Yuma	141	9	58	29.64	29.78	— .01	72.5	— 4.3	101	25	90	46	9	55	45	54	40	36	0.00	0.0	0	5,817	w.	40	sw.	3	30	1	0	0.6	0.0
Independence	3,910	11	42	25.84	29.79	— .05	58.2	— 6.3	85	18	73	32	9	44	39	44	26	32	T.	— 0.6	0	7,672	nw.	40	sw.	25	19	9	3	3.1	0.0
Middle Plateau.							50.0	— 5.6											51	1.67	+ 0.5									4.7	
Reno	4,532	56	63	25.39	29.90	— .01	48.7	— 4.9	78	24	62	26	9	36	42	39	29	54	0.71	— 0.1	7	5,606	w.	36	s.	2	14	11	6	4.2	T.
Tonopah	6,089	12	20	23.96	29.90	.....	47.4	— 4.5	73	29	58	24	8	36	33	36	21	40	0.46	— 0.9	2	10,099	nw.	52	nw.	25	14	15	2	3.6	5.0
Winnemucca	4,344	18	56	25.52	29.91	.00	48.2	— 6.2	79	6	63	21	10	34	44	39	29	56	1.02	0.0	7	4,835	sw.	35	nw.	3	14	11	6	4.6	0.3
Modena	5,479	10	43	24.46	29.77	— .05	48.7	— 5.8	75	29	63	27	27	33	41	41	35	63	1.50	+ 0.1	6	10,860	sw.	60	w.	19	13	11	7	4.8	7.5
Salt Lake City	4,366	105	110	25.46	29.80	— .06	51.8	— 6.5	78	1	62	30	9	42	35	43	33	56	5.76	+ 3.8	13	5,682	se.	38	nw.	19	10	10	11	5.4	3.0
Durango	6,546	18	56	23.52	29.76	— .06	48.6	— 6.4	76	30	64	25	4	33	41	36	23	46	1.68	+ 0.5	6	5,064	nw.	35	sw.	31	13	12	6	4.4	4.9
Grand Junction	4,608	43	51	25.21	29.75	— .08	56.6	— 5.0	84	18	70	32	5	44	39	42	25	39	0.56	— 0.1	5	5,508	nw.	42	s.	31	8	15	8	5.6	0.0
Northern Plateau.							53.4	— 4.5											57	1.57	— 0.1									6.1	
Baker City	3,471	48	58	26.36	29.95	— .01	47.3	— 3.4	80	6	58	30	13	37	39	40	34	63	1.01	— 0.7	10	6,282	n.	29	nw.	31	6	15	10	5.8	0.1
Boise	2,739	78	86	27.06	29.91	— .03	52.6	— 5.0	84	6	63	35	16	42	36	43	32	53	1.38	+ 0.1	9	7,112	nw.	42	sw.	24	6	10	15	6.8	0.0
Lewiston	757	10	51	29.11	29.92	— .04	56.3	— 4.5	90	6	68	39	4	45	46	...	...	...	1.23	— 0.4	11	4,509	e.	42	w.	19	3	9	19	7.4	0.0
Pocatello	4,477	46	54	25.34	29.84	— .05	48.9	— 6.6	78	1	59	32	9	39	34	40	32	59	3.96	+ 1.8	18	7,290	sw.	44	sw.	7	4	19	8	6.0	T.
Spokane	1,929	101	110	27.88	29.93	— .03	52.8	— 3.3	84	6	63	38	4	42	41	44	36	58	0.86	— 0.8	13	4,735	s.	28	s.	29	9	14	8	5.2	0.0
Walla Walla	1,000	71	79	28.89	29.96	.00	56.4	— 4.3	90	6	67	40	30	45	39	46	35	50	0.98	— 0.8	9	5,314	s.	27	w.	6	9	12	10	5.5	0.0
N. Pac. Coast Reg.							50.3	— 2.9											70	2.36	+ 0.3									7.5	
Blaine	57	4	....	29.96	30.02	.....	50.8	.....	65	27	59	36	...	42	28	...	...	...	2.76	.....	13	.....	w.	...	...	...	...	...	...	...	...
North Head	211	11	56	29.94	30.08	+ .05	48.6	— 2.6	59	23	52	41	11	45	12	46	43	82	3.63	+ 1.2	24	13,029	nw.	66	se.	1	0	12	19	8.2	0.0
Port Crescent	259	12	29	29.78	30.07	+ .05	47.1	— 2.0	60	14	54	35	3	40	25	...	...	...	1.46	— 0.8	17	3,629	nw.	14	ne.	6	4	15	12	6.6	0.0
Seattle	123	185	224	29.94	30.07	+ .06	51.6	— 3.4	71	23	59	41	8	45	26	49	47	86	3.19	+ 0.9	15	5,591	s.	35	sw.	1	0	15	16	7.9	0.0
Tacoma	213	118	120	29.80	30.03	+ .01	51.0	— 3.5	72	23	58	40	17	43	29	47	42	76	2.82	+ 0.3	17	3,794	sw.	25	sw.	18	6	8	17	7.1	0.0

TABLE 1.—*Climatological data for U. S. Weather Bureau stations, May, 1908*—Continued.

Stations.	Elevation of instruments.			Pressure, in inches.			Temperature of the air, in degrees Fahrenheit.									Mean wet thermometer.	Mean temperature of the dew-point.	Mean relative humidity, per cent.	Precipitation, in inches.			Wind.				Clear days.	Partly cloudy days.	Cloudy days.	Average cloudiness during daylight, tenths.	Total snowfall.
	Barometer above sea level, feet.	Thermometers above ground.	Anemometer above ground.	Actual, reduced to mean of 24 hours.	Sea level, reduced to mean of 24 hrs.	Departure from normal.	Mean max. + mean min. ÷ 2.	Departure from normal.	Maximum.	Date.	Mean maximum.	Minimum.	Date.	Mean minimum.	Greatest daily range.				Total.	Departure from normal.	Days with .01, or more.	Total movement, miles.	Prevailing direction.	Maximum velocity. Miles per hour.	Maximum velocity. Direction.	Maximum velocity. Date.					
N. P. Coast Reg.—Cont.																													
Tatoosh Island	86	7	57	29.94	30.04	+ .03	49.2	— 0.4	62	6	53	43	2	45	15	46	43	81	2.79	— 1.3	17	10,234	s.	50	s.	7	1	5	25	8.7	
Portland, Oreg	153	68	106	29.90	30.06	+ .03	52.8	— 4.0	77	23	61	38	9	45	33	47	42	72	4.66	+ 2.3	20	4,630	nw.	26	sw.	2	3	8	20	7.3	
Roseburg	510	9	57	29.53	30.09	+ .06	51.8	— 4.2	80	23	63	32	10	40	39	46	41	75	1.47	— 0.6	16	8,023	nw.	21	sw.	2	4	15	12	6.5	
Mid. Pac. Coast Reg.							56.8	— 2.8										67	1.09	— 0.1									3.1	
Eureka	62	62	80	30.05	30.12	+ .07	50.0	— 2.1	63	17	55	39	8	45	18	46	43	81	2.57	0.0	13	8,443	n.	41	n.	26	15	11	5	4.3	
Mount Tamalpais	2,375	11	18	27.52	30.00	.00	50.7	.....	77	23	58	34	2	43	23	45	41	74	1.44	+ 0.5	11	16,559	nw.	76	nw.	20	22	6	3	2.6	
Point Reyes Light	490	7	18	29.45	29.97	.....	49.2	.....	58	17	53	43	9	46	12	.....	.....	.....	0.48	.....	6	26,405	nw.	96	nw.	11	21	8	2	2.3	
Red Bluff	332	50	56	29.58	29.94	— .01	61.6	— 4.9	91	28	73	40	16	50	33	50	37	49	1.05	— 0.3	6	6,541	nw.	35	n.	30	15	6	10	4.4	
Sacramento	69	106	117	29.88	29.95	+ .01	61.0	— 1.9	89	24	72	41	15	50	34	52	45	60	0.54	— 0.4	5	7,419	nw.	29	nw.	26	23	6	2	2.4	
San Francisco	155	200	204	29.85	30.02	+ .03	55.4	— 0.1	79	27	62	46	8	48	30	48	44	71	0.76	0.0	6	6,569	w.	27	sw.	28	17	12	2	3.1	
San Jose	141	78	88	29.86	30.01	.....	55.9	— 4.8	87	23	69	37	10	43	43	.....	.....	.....	0.67	— 0.1	7	5,659	nw.	31	se.	1	20	10	1	3.1	
Southeast Farallon	30	9	17	30.00	30.03	.....	50.0	.....	57	17	52	46	2	48	9	.....	.....	.....	0.60	— 0.2	5	19,442	nw.	58	nw.	29	18	11	2	2.9	
S. Pac. Coast Reg.							59.0	— 2.6										67	0.31	— 0.3									2.6	
Fresno	330	67	70	29.59	29.94	+ .02	63.6	— 4.8	94	24	78	40	8	49	40	51	38	50	0.63	0.0	3	6,284	nw.	24	nw.	18	23	5	3	2.2	
Los Angeles	338	116	123	29.57	29.94	— .01	59.8	— 0.7	77	18	69	45	3	50	29	52	47	70	0.25	— 0.2	1	4,547	sw.	27	sw.	2	19	9	3	3.1	
San Diego	87	94	102	29.86	29.95	.00	57.4	— 3.4	68	18	62	47	9	53	18	52	49	75	0.16	— 0.2	1	5,264	w.	28	w.	2	26	4	1	2.4	
San Luis Obispo	201	47	54	29.80	30.02	+ .02	55.2	— 1.5	86	23	66	36	3	44	43	48	43	73	0.21	— 0.7	3	5,577	nw.	26	w.	7	20	11	0	2.8	
West Indies.																													
Grand Turk	11	6	20	30.01	30.02	+ .02	80.8	.....	89	20	86	68	22	75	.....	.....	.....	.....	5.00	.....	7	.....	.....	.....	.....	.....	.....	.....	.....	.....	
San Juan	82	48	90	29.92	30.01	+ .02	79.4	.....	90	10	85	71	23	74	16	73	70	75	2.63	— 2.0	9	8,069	se.	33	se.	25	8	15	8	5.2	
Panama.																													
Christobal	74	.....	.....	29.84	29.86	.....	78.8	.....	89	31	83	71	15	74	17	76	75	90	22.49	.....	28	4,950	n.	36	n.	19	4	10	17	7.0	
Bas Obispo	40	.....	.....	29.69	29.86	.....	78.8	.....	91	7	85	68	15	72	20	74	74	94	13.16	.....	28	2,726	nw.	19	nw.	3	0	10	21	8.0	
Ancon	.....	.....	.....	29.78	29.85	.....	80.2	.....	93	26	87	71	14	73	18	75	74	88	7.64	.....	21	4,742	nw.	25	sw.	27	0	15	16	7.0	
Alhajuela	.....	.....	.....	.....	.....	.....	79.6	.....	90	9	87	60	10	71	27	.....	.....	.....	19.72	.....	26	1,094	ne.	18	n.	29	.....	.....	.....	.....	
Bohio	.....	.....	.....	.....	.....	.....	79.3	.....	90	20	86	69	20	73	21	.....	.....	.....	18.59	.....	25	1,323	e.	12	nw.	17	.....	.....	.....	.....	
Gatun	.....	.....	.....	.....	.....	.....	79.0	.....	90	7	86	70	15	72	19	.....	.....	.....	17.30	.....	29	2,739	s.	23	n.	25	.....	.....	.....	.....	

TABLE II.—*Accumulated amounts of precipitation for each 5 minutes, for storms in which the rate of fall equaled or exceeded 0.25 in any 5 minutes, or 0.80 inch in 1 hour, during May, 1908, at all stations furnished with self-registering gages.*

Stations.	Date.	Total duration. From—	Total duration. To—	Total amount of precipitation.	Excessive rate. Began—	Excessive rate. Ended—	Amount before excessive began.	Depths of precipitation (in inches) during periods of time indicated. 5 min.	10 min.	15 min.	20 min.	25 min.	30 min.	35 min.	40 min.	45 min.	50 min.	60 min.	80 min.	100 min.	120 min.
Abilene, Tex	22	7:55 p. m.	10:45 p. m.	4.45	8:53 p. m.	9:40 p. m.	0.02	0.35	0.52	0.82	1.06	1.42	1.77	2.10	2.41	2.56	2.60	2.70	3.17	4.17	4.42
Do	23–24	6:35 p. m.	7:10 a. m.	1.28	7:50 p. m.	8:15 p. m.	0.10	0.15	0.34	0.42	0.69	0.75	.....	.....	.....	.....	.....	.....	.....	.....	.....
Albany, N. Y	29	6:10 p. m.	7:35 p. m.	0.97	6:16 p. m.	6:32 p. m.	0.01	0.48	0.80	0.91	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Alpena, Mich	30	1:53 p. m.	5:00 p. m.	1.07	1:54 p. m.	2:24 p. m.	T.	0.20	0.35	0.37	0.41	0.47	0.54	.....	.....	.....	.....	.....	.....	.....	.....
					3:51 p. m.	4:09 p. m.	0.59	0.09	0.17	0.32	0.41	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Amarillo, Tex	22	7:30 a. m.	3:34 p. m.	1.79	8:31 a. m.	9:09 a. m.	0.07	0.15	0.36	0.38	0.40	0.44	0.73	0.88	0.93	.....	.....	.....	.....	.....	.....
Anniston, Ala	5	5:39 a. m.	6:35 p. m.	1.31	5:39 a. m.	5:58 a. m.	0.00	0.23	0.30	0.36	0.40	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Atlanta, Ga	29	1:48 p. m.	4:50 p. m.	0.79	2:13 p. m.	2:33 p. m.	0.08	0.07	0.20	0.37	0.43	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Atlantic City, N. J	14–15	D. N., 14th.	D. N., 15th.	1.16	a11:34 p. m.	b12:15 a. m.	0.43	0.07	0.21	0.30	0.35	0.42	0.51	0.56	0.62	0.67	.....	.....	.....	.....	.....
Bentonville, Ark	4	10:45 a. m.	1:10 p. m.	1.04	11:08 a. m.	11:38 a. m.	0.06	0.13	0.22	0.27	0.31	0.57	0.67	.....	.....	.....	.....	.....	.....	.....	.....
Binghamton, N. Y	30	5:55 p. m.	8:45 p. m.	1.09	6:51 p. m.	7:26 p. m.	0.28	0.05	0.31	0.46	0.59	0.66	0.71	0.76	.....	.....	.....	.....	.....	.....	.....
Birmingham, Ala	5	4:16 a. m.	4:35 p. m.	2.56	4:42 a. m.	5:12 a. m.	0.03	0.06	0.18	0.30	0.43	0.48	0.52	.....	.....	.....	.....	.....	.....	.....	.....
Do	26	1:06 p. m.	2:35 p. m.	0.76	1:18 p. m.	1:38 p. m.	0.01	0.05	0.23	0.47	0.63	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Block Island, R. I	22	8:25 p. m.	10:20 p. m.	0.94	9:08 p. m.	9:48 p. m.	0.10	0.20	0.28	0.32	0.38	0.41	0.53	0.66	0.72	.....	.....	.....	.....	.....	.....
Do	23	3:30 a. m.	7:15 a. m.	1.07	5:47 a. m.	6:37 a. m.	0.06	0.23	0.48	0.66	0.75	0.77	0.79	0.81	0.86	0.90	0.95	.....	.....	.....	.....
Cairo, Ill	4–5	9:50 p. m.	D. N., a. m.	1.79	10:51 p. m.	11:32 p. m.	0.02	0.21	0.33	0.45	0.63	0.88	1.09	1.15	1.20	1.24	.....	.....	.....	.....	.....
Cape Henry, Va	30	7:12 p. m.	8:20 p. m.	0.57	7:14 p. m.	7:30 p. m.	0.01	0.18	0.35	0.47	0.51	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Charleston, S. C	17	7:28 p. m.	10:20 p. m.	0.62	7:55 p. m.	8:10 p. m.	0.10	0.09	0.27	0.38	0.41	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Chicago, Ill	28	4:45 a. m.	8:18 a. m.	0.80	6:14 a. m.	6:23 a. m.	0.11	0.14	0.41	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
		7:12 p. m.	10:11 p. m.	0.81	7:38 p. m.	7:58 p. m.	0.03	0.10	0.26	0.38	0.49	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Cincinnati, Ohio	25	3:31 p. m.	4:05 p. m.	0.82	3:34 p. m.	3:54 p. m.	0.01	0.24	0.49	0.68	0.79	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Columbia, Mo	5–6	5:35 p. m.	D. N., 6th.	0.87	7:38 p. m.	7:58 p. m.	0.04	0.16	0.32	0.54	0.62	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Do	21	2:15 p. m.	2:58 p. m.	0.74	2:20 p. m.	2:40 p. m.	0.03	0.10	0.22	0.41	0.68	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Do	28	2:18 p. m.	3:04 p. m.	0.92	2:28 p. m.	2:48 p. m.	0.02	0.31	0.61	0.76	0.86	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Columbia, S. C	23	4:50 p. m.	6:10 p. m.	0.87	4:56 p. m.	5:45 p. m.	0.01	0.08	0.21	0.33	0.45	0.59	0.68	0.72	0.75	0.77	0.86	.....	.....	.....	.....
Concordia, Kans	20–21	9:23 p. m.	4:00 a. m.	1.67	12:19 a. m.	12:44 a. m.	0.98	0.25	0.32	0.37	0.43	0.48	.....	.....	.....	.....	.....	.....	.....	.....	.....
Do	27	7:10 p. m.	9:18 p. m.	1.39	8:12 p. m.	8:50 p. m.	0.28	0.10	0.26	0.39	0.46	0.62	0.78	0.91	1.05	.....	.....	.....	.....	.....	.....
Corpus Christi, Tex	14–15	7:31 p. m.	12:15 a. m.	2.02	8:25 p. m.	9:45 p. m.	0.02	0.05	0.17	0.31	0.37	0.44	0.60	0.80	0.91	1.06	1.18	1.46	1.61	.....	.....
Del Rio, Tex	23–24	11:55 p. m.	2:15 a. m.	1.87	12:03 a. m.	12:33 a. m.	0.04	0.32	0.75	1.17	1.38	1.52	1.64	.....	.....	.....	.....	.....	.....	.....	.....
Des Moines, Iowa	12–13	8:05 p. m.	12:25 a. m.	1.52	8:59 p. m.	9:16 p. m.	0.32	0.17	0.32	0.44	0.45	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Do	24–25	9:03 p. m.	4:15 a. m.	1.12	9:32 p. m.	10:06 p. m.	0.14	0.17	0.22	0.28	0.30	0.41	0.52	0.59	.....	.....	.....	.....	.....	.....	.....
Do	25	2:10 p. m.	3:25 p. m.	0.76	2:13 p. m.	2:42 p. m.	0.01	0.08	0.26	0.42	0.44	0.59	0.69	.....	.....	.....	.....	.....	.....	.....	.....
Detroit, Mich	26	2:25 p. m.	3:45 p. m.	0.66	2:36 p. m.	2:53 p. m.	0.01	0.24	0.33	0.45	0.55	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Dubuque, Iowa	25–26	10:32 p. m.	D. N., 26th.	0.80	10:40 p. m.	11:20 p. m.	T.	0.18	0.39	0.47	0.55	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Evansville, Ind	6	3:05 p. m.	7:16 p. m.	1.80	3:10 p. m.	3:30 p. m.	0.01	0.45	0.72	0.79	0.86	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
					4:00 p. m.	4:15 p. m.	1.07	0.14	0.33	0.42	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Do	22	12:27 a. m.	8:47 a. m.	2.82	12:55 a. m.	2:05 a. m.	0.12	0.08	0.17	0.25	0.31	0.33	0.43	0.45	0.46	0.49	0.61	1.17	1.47	.....	.....
Fort Smith, Ark	12–13	5:05 p. m.	D. N., 13th.	2.70	6:08 p. m.	6:42 p. m.	0.04	0.15	0.26	0.35	0.46	0.80	1.03	1.14	.....	.....	.....	.....	.....	.....	.....
Do	13	1:57 p. m.	8:21 p. m.	2.47	2:09 p. m.	3:16 p. m.	0.02	0.09	0.21	0.29	0.34	0.39	0.50	0.57	0.62	0.72	0.79	0.98	1.08	.....	.....
Do	22	2:15 a. m.	4:30 a. m.	0.93	2:56 a. m.	3:21 a. m.	0.03	0.10	0.27	0.61	0.73	0.82	.....	.....	.....	.....	.....	.....	.....	.....	.....
Fort Worth, Tex	13	10:12 a. m.	1:55 p. m.	1.70	12:22 p. m.	1:14 p. m.	0.03	0.13	0.19	0.36	0.43	0.49	0.78	1.15	1.40	1.53	1.61	.....	.....	.....	.....
Do	23	4:20 p. m.	9:10 p. m.	3.40	4:35 p. m.	6:16 p. m.	0.02	0.19	0.30	0.42	0.55	0.66	0.75	1.04	1.24	1.44	1.60	1.95	2.37	2.94	.....
Do	23–24	10:55 p. m.	11:30 a. m.	3.47	6:00 a. m.	6:30 a. m.	1.90	0.10	0.23	0.34	0.45	0.57	0.63	.....	.....	.....	.....	.....	.....	.....	.....
Galveston, Tex	24	3:10 p. m.	5:15 p. m.	1.78	3:13 p. m.	4:00 p. m.	0.01	0.32	0.62	0.82	0.89	1.12	1.25	1.40	1.52	1.56	1.59	.....	.....	.....	.....
Hartford, Conn	30	1:45 p. m.	D. N., p. m.	2.54	7:20 p. m.	8:42 p. m.	0.93	0.09	0.17	0.22	0.30	0.37	0.46	0.54	0.62	0.70	0.75	0.92	1.15	1.27	.....
Hatteras, N. C	21	5:05 p. m.	9:35 p. m.	2.20	7:05 p. m.	7:53 p. m.	0.37	0.08	0.17	0.33	0.37	0.41	0.51	0.72	0.88	1.00	1.10	.....	.....	.....	.....
Do	22	12:25 a. m.	5:35 a. m.	2.17	1:28 a. m.	2:25 a. m.	0.24	0.13	0.23	0.24	0.31	0.55	0.72	0.93	0.96	1.01	1.24	1.39	.....	.....	.....
Havre, Mont	25	2:25 p. m.	4:30 p. m.	0.58	3:10 p. m.	3:23 p. m.	0.13	0.17	0.36	0.42	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Huron, S. Dak	13–14	4:25 p. m.	5:40 a. m.	3.43	5:13 p. m.	6:48 p. m.	0.10	0.09	0.15	0.26	0.37	0.58	0.77	0.79	0.86	0.92	0.96	1.14	1.58	1.85	.....
Iola, Kans	4	2:05 a. m.	6:00 a. m.	1.07	2:15 a. m.	2:50 a. m.	0.05	0.09	0.21	0.29	0.40	0.47	0.52	0.58	.....	.....	.....	.....	.....	.....	.....
Jupiter, Fla	6	3:50 p. m.	7:20 p. m.	1.55	4:03 p. m.	5:03 p. m.	0.02	0.06	0.16	0.39	0.56	0.78	0.94	1.11	1.16	1.18	1.20	1.29	.....	.....	.....
Keokuk, Iowa	3–4	2:15 p. m.	11:15 a. m.	1.95	6:04 a. m.	6:16 a. m.	1.00	0.23	0.46	0.51	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Do	12	5:50 p. m.	8:20 p. m.	0.94	7:39 p. m.	8:01 p. m.	0.13	0.20	0.34	0.42	0.71	0.78	.....	.....	.....	.....	.....	.....	.....	.....	.....
Do	18	1:45 a. m.	5:50 a. m.	0.74	1:48 a. m.	2:03 a. m.	0.01	0.22	0.34	0.51	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....

TABLE II.—*Accumulated amounts of precipitation for each 5 minutes, etc.*—Continued.

Stations.	Date.	Total duration. From—	Total duration. To—	Total amount of precipitation.	Excessive rate. Began—	Excessive rate. Ended—	Amount before excessive began.	Depths of precipitation (in inches) during periods of time indicated. 5 min.	10 min.	15 min.	20 min.	25 min.	30 min.	35 min.	40 min.	45 min.	50 min.	60 min.	80 min.	100 min.	120 min.
Keokuk, Iowa	27-28	11:15 p. m.	4:45 a. m.	2.07	11:26 p. m.	11:39 p. m.	0.03	0.23	0.46	0.52	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
					12:09 a. m.	12:37 a. m.	0.68	0.13	0.34	0.47	0.55	0.62	0.68	.....	.....	.....	.....	.....	.....	.....	.....
Knoxville, Tenn	19	11:45 a. m.	2:00 p. m.	0.86	12:47 p. m.	12:59 p. m.	0.01	0.32	0.69	0.76	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
La Crosse, Wis	29	2:27 p. m.	3:45 p. m.	1.42	2:52 p. m.	3:35 p. m.	0.11	0.18	0.30	0.31	0.32	0.34	0.40	0.71	1.19	1.30	.....	.....	.....	.....	.....
Little Rock, Ark	4	6:00 p. m.	9:45 p. m.	1.36	6:20 p. m.	7:28 p. m.	0.02	0.06	0.09	0.18	0.34	0.54	0.63	0.68	0.75	0.89	1.03	1.14	1.30	.....	.....
Louisville, Ky	6	3:28 p. m.	5:25 p. m.	1.01	4:30 p. m.	4:50 p. m.	0.31	0.13	0.22	0.41	0.67	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Lynchburg, Va	21	12:10 p. m.	1:05 p. m.	0.63	12:19 p. m.	12:40 p. m.	T.	0.29	0.39	0.44	0.49	0.53	.....	.....	.....	.....	.....	.....	.....	.....	.....
Macon, Ga	18	8:36 p. m.	D. N.	1.38	8:38 p. m.	9:18 p. m.	0.01	0.32	0.69	0.88	0.97	1.07	1.11	1.14	1.22	.....	.....	.....	.....	.....	.....
Madison, Wis	18	5:35 a. m.	7:05 a. m.	0.70	5:48 a. m.	6:03 a. m.	0.01	0.18	0.52	0.58	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Do	25	7:01 p. m.	8:05 p. m.	0.79	7:03 p. m.	7:48 p. m.	0.01	0.13	0.26	0.37	0.41	0.41	0.43	0.47	0.64	0.77	.....	.....	.....	.....	.....
Memphis, Tenn	4-5	8:50 p. m.	D. N. a. m.	1.10	10:34 p. m.	10:53 p. m.	0.03	0.19	0.37	0.57	0.64	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Do	25	1:00 p. m.	1:22 p. m.	0.69	1:08 p. m.	1:22 p. m.	0.03	0.20	0.56	0.66	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Meridian, Miss	5	6:35 a. m.	2:20 p. m.	4.04	8:03 a. m.	8:41 a. m.	0.18	0.37	0.83	0.99	1.11	1.27	1.43	1.55	1.62	.....	.....	.....	.....	.....	.....
					9:50 a. m.	10:17 a. m.	2.20	0.44	0.90	1.10	1.22	1.32	1.37	.....	.....	.....	.....	.....	.....	.....	.....
Milwaukee, Wis	25	1:55 p. m.	2:28 p. m.	0.67	2:03 p. m.	2:23 p. m.	0.05	0.22	0.42	0.53	0.58	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Minneapolis, Minn	27	1:48 a. m.	5:10 a. m.	1.28	2:16 a. m.	2:46 a. m.	0.18	0.23	0.34	0.39	0.46	0.53	0.67	.....	.....	.....	.....	.....	.....	.....	.....
					3:22 a. m.	3:30 a. m.	0.91	0.17	0.31	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Mobile, Ala	5-6	1:30 p. m.	D. N. a. m.	3.50	2:49 p. m.	4:42 p. m.	0.26	0.07	0.15	0.24	0.32	0.39	0.54	0.74	1.05	1.16	1.23	1.49	1.92	2.15	2.35
Montgomery, Ala	29-30	10:50 p. m.	D. N. a. m.	1.44	11:21 p. m.	12:07 a. m.	0.02	0.08	0.15	0.23	0.35	0.60	0.85	1.13	1.35	1.39	1.41	.....	.....	.....	.....
New Haven, Conn	30	3:50 p. m.	10:20 p. m.	2.38	4:40 p. m.	5:20 p. m.	0.22	0.05	0.11	0.17	0.27	0.40	0.53	0.68	0.75	.....	.....	.....	.....	.....	.....
					6:15 p. m.	6:45 p. m.	1.16	0.08	0.14	0.24	0.32	0.44	0.51	.....	.....	.....	.....	.....	.....	.....	.....
New Orleans, La	5	3:39 p. m.	8:45 p. m.	2.14	5:50 p. m.	7:07 p. m.	0.24	0.15	0.25	0.29	0.35	0.40	0.43	0.51	0.69	0.73	0.85	1.00	1.30	.....	.....
New York, N. Y	7	4:20 a. m.	11:40 p. m.	4.16	2:56 p. m.	3:56 p. m.	1.90	0.15	0.21	0.25	0.32	0.35	0.38	0.40	0.43	0.45	0.49	0.81	.....	.....	.....
Norfolk, Va	19	9:25 a. m.	10:50 a. m.	0.70	9:29 a. m.	9:37 a. m.	0.01	0.26	0.49	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Do	30	7:05 p. m.	7:50 p. m.	0.60	7:18 p. m.	7:37 p. m.	0.04	0.07	0.24	0.44	0.53	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Oklahoma, Okla	13	8:50 a. m.	10:00 a. m.	0.60	8:56 a. m.	9:11 a. m.	0.01	0.14	0.32	0.45	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Do	22-23	5:20 p. m.	4:00 a. m.	2.76	5:44 p. m.	6:19 p. m.	0.01	0.05	0.10	0.19	0.44	0.76	0.90	0.95	.....	.....	.....	.....	.....	.....	.....
Do	23-24	7:45 a. m.	D. N. a. m.	4.21	10:35 a. m.	11:10 a. m.	0.18	0.07	0.11	0.17	0.34	0.51	0.64	0.74	.....	.....	.....	.....	.....	.....	.....
					12:38 p. m.	1:18 p. m.	1.15	0.06	0.27	0.33	0.38	0.57	0.66	0.74	0.81	.....	.....	.....	.....	.....	.....
Omaha, Nebr	12	4:20 p. m.	6:50 p. m.	1.16	5:02 p. m.	6:12 p. m.	0.02	0.05	0.14	0.21	c. 27	0.34	0.49	0.61	0.64	0.70	0.72	0.86	1.14	.....	.....
Oswego, N. Y	26	12:07 p. m.	12:41 p. m.	0.59	12:21 p. m.	12:30 p. m.	0.01	0.39	0.49	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Palestine, Tex	13	3:46 p. m.	11:00 p. m.	4.82	4:00 p. m.	4:59 p. m.	0.06	0.05	0.22	0.46	0.60	0.60	0.65	0.67	0.72	0.83	0.94	.....	.....	.....	.....
					4:59 p. m.	5:49 p. m.	.....	1.30	1.65	1.98	2.46	2.49	2.65	2.74	2.87	3.01	3.07	.....	.....	.....	.....
					5:49 p. m.	6:39 p. m.	.....	3.23	3.40	3.67	3.79	3.89	3.95	4.02	4.16	4.24	4.34	.....	.....	.....	.....
Do	17	3:30 a. m.	6:05 a. m.	0.84	3:43 a. m.	4:08 a. m.	0.01	0.16	0.36	0.55	0.61	0.66	.....	.....	.....	.....	.....	.....	.....	.....	.....
Peoria, Ill	21	5:30 p. m.	D. N. p. m.	0.71	5:38 p. m.	6:03 p. m.	0.01	0.07	0.20	0.31	0.44	0.52	.....	.....	.....	.....	.....	.....	.....	.....	.....
Philadelphia, Pa	6-7	9:45 p. m.	7:47 p. m.	2.70	6:17 p. m.	6:47 p. m.	1.72	0.18	0.43	0.52	0.69	0.75	0.80	.....	.....	.....	.....	.....	.....	.....	.....
Do	22	4:45 p. m.	6:20 p. m.	1.06	5:06 p. m.	5:23 p. m.	0.01	0.15	0.34	0.98	1.03	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Portland, Me	30-31	8:03 p. m.	3:30 a. m.	1.64	10:25 p. m.	11:00 p. m.	0.37	0.06	0.18	0.29	0.49	0.69	0.70	0.78	.....	.....	.....	.....	.....	.....	.....
Rapid City, S. Dak	26	3:50 p. m.	7:15 p. m.	0.97	4:00 p. m.	4:24 p. m.	0.02	0.18	0.33	0.41	0.48	0.53	.....	.....	.....	.....	.....	.....	.....	.....	.....
Do	31-1‡	7:50 p. m.	8:35 a. m.	2.04	10:16 p. m.	10:47 p. m.	0.46	0.05	0.18	0.33	0.43	0.46	0.56	0.60	.....	.....	.....	.....	.....	.....	.....
Richmond, Va	18	2:49 p. m.	3:36 p. m.	0.58	2:58 p. m.	3:23 p. m.	0.01	0.15	0.29	0.39	0.44	0.54	.....	.....	.....	.....	.....	.....	.....	.....	.....
Do	19	4:09 a. m.	6:12 a. m.	1.17	4:02 a. m.	5:12 a. m.	0.01	0.06	0.11	0.15	0.24	0.29	0.46	0.57	0.58	0.63	0.65	0.82	1.04	.....	.....
Do	20	2:10 p. m.	6:18 p. m.	1.41	2:36 p. m.	2:58 p. m.	0.06	0.11	0.27	0.75	1.03	1.13	.....	.....	.....	.....	.....	.....	.....	.....	.....
St. Louis, Mo	5	8:25 p. m.	D. N. p. m.	1.14	8:31 p. m.	9:16 p. m.	0.01	0.10	0.15	0.17	0.23	0.46	0.71	0.76	0.89	0.97	.....	.....	.....	.....	.....
Do	27	11:41 a. m.	1:45 p. m.	1.14	11:52 a. m.	12:42 p. m.	0.01	0.05	0.12	0.20	0.37	0.60	0.72	0.80	0.86	0.97	1.02	.....	.....	.....	.....
San Antonio, Tex	25	7:35 a. m.	11:56 a. m.	0.91	10:53 a. m.	11:53 a. m.	0.07	0.08	0.20	0.28	0.34	0.39	0.43	0.45	0.50	0.57	0.71	0.83	.....	.....	.....
Do	30	12:30 a. m.	2:25 a. m.	1.84	12:43 a. m	1:23 a. m.	0.05	0.07	0.16	0.33	0.73	1.09	1.25	1.42	1.47	.....	.....	.....	.....	.....	.....
San Juan, P. R.	25	3:20 p. m.	8:20 p. m.	1.18	5:07 p. m.	5:40 p. m.	0.08	0.10	0.18	0.27	0.42	0.60	0.67	0.70	.....	.....	.....	.....	.....	.....	.....
Savannah, Ga	30	3:47 p. m.	6:15 p. m.	0.90	3:56 p. m.	4:40 p. m.	0.01	0.07	0.13	0.20	0.23	0.31	0.43	0.62	0.73	0.77	.....	.....	.....	.....	.....
Shreveport, La	13	1:00 a. m.	10:00 a. m.	6.53	1:58 a. m.	2:58 a. m.	0.04	0.23	0.41	0.51	0.52	0.75	0.97	1.02	1.14	1.36	1.57	.....	.....	.....	.....
					4:04 a. m.	4:48 a. m.	1.68	0.23	0.47	0.84	1.25	1.55	1.81	2.23	2.43	2.52	2.72	3.15	3.61	3.97	4.09
Do	13-14	7:20 p. m.	6:40 a. m.	1.93	7:33 p. m.	8:10 p. m.	0.01	0.06	0.17	0.39	0.62	0.71	0.93	1.02	1.06	.....	.....	.....	.....	.....	.....
Springfield, Ill	21	5:40 p. m.	8:30 p. m.	1.38	5:58 p. m.	6:42 p. m.	0.06	0.19	0.34	0.60	0.77	0.93	1.04	1.08	1.17	1.22	.....	.....	.....	.....	.....
Tampa, Fla	4	6:45 p. m.	9:40 p. m.	1.39	6:50 p. m.	7:25 p. m.	T.	0.27	0.53	0.80	0.92	1.07	1.18	1.23	.....	.....	.....	.....	.....	.....	.....
Taylor, Tex	17	6:05 a. m.	8:10 a. m.	1.41	6:40 a. m.	7:40 a. m.	T.	0.08	0.21	0.30	0.43	0.64	0.71	0.80	1.00	1.11	1.15	1.30	.....	.....	.....
Do	23-24	11:45 p. m.	10:30 a. m	4.53	11. 55 p. m.	3:05 a. m.	0.01	0.10	0.19	0.22	0.30	0.46	0.53	0.56	0.62	0.69	0.71	.....	.....	.....	.....
								0.81	0.88	0.98	1.03	1.08	1.13	1.15	1.24	1.31	1.32	.....	.....	.....	.....
								1.33	1.37	1.51	1.60	1.64	1.70	1.78	1.86	1.97	2.01	.....	.....	.....	.....
								2.08	2.14	2.21	2.27	2.32	2.51	2.69	2.68	.....	.....	.....	.....	.....	.....
Thomasville, Ga	5-6	7:58 p. m.	12:20 p. m.	2.86	9:03 p. m.	9:36 p. m.	0.16	0.20	0.29	0.41	0.52	0.89	1.15	1.26	.....	.....	.....	.....	.....	.....	.....
Topeka, Kans	13	1:15 p. m.	2:15 p. m.	0.64	1:21 p. m.	1:36 p. m.	0.01	0.29	0.47	0.57	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Vicksburg, Miss	5	D. N.	6:25 a. m.	3.38	3:02 a. m.	3:52 a. m.	0.30	0.15	0.29	0.37	0.55	0.65	0.81	0.92	1.06	1.13	1.27	.....	.....	.....	.....
					3:52 a. m.	4:42 a. m.	.....	1.36	1.54	1.72	1.80	1.85	1.86	1.88	1.91	2.05	2.19	.....	.....	.....	.....
					4:42 a. m.	5:28 a. m.	.....	2.26	2.37	2.53	2.59	2.66	2.72	2.81	2.91	2.95	3.00	.....	.....	.....	.....
Washington, D. C	29	2:38 p. m.	3:55 p. m.	1.04	2:42 p. m.	3:40 p. m.	0.03	0.07	0.18	0.23	0.24	0.25	0.30	0.35	0.44	0.67	0.84	0.99	.....	.....	.....
Do	30	6:20 p. m.	8:15 p. m.	0.67	6:25 p. m.	6:37 p. m.	0.01	0.27	0.56	0.63	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Wichita, Kans	11	12:10 a. m.	1:30 a. m.	0.92	12:21 a. m.	12:50 a. m.	0.02	0.12	0.25	0.46	0.66	0.82	0.89	.....	.....	.....	.....	.....	.....	.....	.....
Do	31-1‡	12:40 p. m.	D. N.	3.70	4:48 p. m.	5:38 p. m.	1.22	0.27	0.43	0.66	1.00	1.22	1.32	1.41	1.46	1.50	1.57	.....	.....	.....	.....
Wilmington, N. C	6	12:50 p. m.	3:15 p. m.	0.68	2:37 p. m.	2:54 p. m.	0.16	0.09	0.15	0.39	0.51	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Do	29	6:44 p. m.	8:02 p. m.	0.72	7:03 p. m.	7:22 p. m.	T.	0.12	0.29	0.52	0.68	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....

•Self-register not working. †Estimated. ‡June 1. ▪14th. ▹15th.

DESCRIPTION OF TABLES AND CHARTS.

By Mr. P. C. DAY, Assistant Chief, Division of Meteorological Records.

For description of tables and charts see page 8 of REVIEW for January, 1908.

TABLE III.—*Data furnished by the Canadian Meteorological Service, May, 1908.*

Stations.	Pressure.			Temperature.				Precipitation.			Stations.	Pressure.			Temperature.				Precipitation.		
	Actual, reduced to mean of 24 hours.	Sea level, reduced to mean of 24 hours.	Departure from normal.	Mean.	Departure from normal.	Mean maximum.	Mean minimum.	Total.	Departure from normal.	Total snowfall.		Actual, reduced to mean of 24 hours.	Sea level, reduced to mean of 24 hours.	Departure from normal.	Mean.	Departure from normal.	Mean maximum.	Mean minimum.	Total.	Departure from normal.	Total snowfall.
	Ins.	*Ins.*	*Ins.*	°	°	°	°	*Ins.*	*Ins.*	*Ins.*		*Ins.*	*Ins.*	*Ins.*	°	°	°	°	*Ins.*	*Ins.*	*Ins.*
St. Johns, N. F	29.78	29.92	—.06	42.3	— 0.6	49.7	35.0	2.39	—1.27	0.3	Parry Sound, Ont	29.22	29.91	—.04	55.6	+ 4.5	65.7	45.5	2.34	—0.59	1.0
Sydney, C. B. I	29.96	30.00	+.03	46.6	+ 1.4	55.8	37.3	4.13	+0.36	0.5	Port Arthur, Ont	29.24	29.95	—.01	49.4	+ 3.5	59.6	39.1	2.85	+0.70	....
Halifax, N. S	29.88	29.99	+.01	49.8	+ 1.4	59.4	40.2	6.24	+1.98	.....	Winnipeg, Man	29.12	29.95	—.01	52.2	+ 0.6	64.5	39.9	3.01	+0.73	....
Grand Manan, N. B	29.88	29.93	—.04	49.6	+ 1.7	56.8	42.4	3.86	+0.25	.....	Minnedosa, Man	28.13	29.94	—.02	50.1	+ 2.7	62.9	37.2	2.09	+0.64	T.
Yarmouth, N. S	29.91	29.98	.00	48.8	+ 1.2	56.5	41.2	3.81	+0.01	.....	Regina, Sask	27.93	.....	.....	51.3	+ 1.5	65.2	37.5	1.19	—0.46	1.8
Charlottetown, P. E. I	29.93	29.97	+.01	48.2	+ 1.3	56.4	40.0	4.13	+1.22	.....	Medicine Hat, Alberta	27.52	29.78	—.11	58.2	+ 4.1	70.9	45.5	2.98	—1.67	....
Chatham, N. B	29.93	29.95	.00	51.3	+ 2.8	61.8	40.8	3.71	+0.50	0.7	Swift Current, Sask	27.34	29.89	—.03	53.3	+ 2.6	66.6	40.0	0.70	—1.06	....
Father Point, Que	29.92	29.94	+.01	44.7	+ 0.7	51.8	37.5	3.79	+1.21	.....	Calgary, Alberta	26.34	29.85	—.03	50.0	+ 1.0	61.8	38.3	4.59	+2.82	....
Quebec, Que	29.59	29.90	—.04	51.9	+ 2.0	60.8	42.9	3.78	+0.70	.....	Banff, Alberta	25.30	29.86	—.02	45.6	— 1.4	55.7	35.5	4.14	+2.10	T.
Montreal, Que	29.68	29.89	—.05	57.1	+ 1.4	65.6	48.5	5.61	+3.66	.....	Edmonton, Alberta	27.55	29.81	—.07	54.5	+ 3.7	66.9	42.2	2.58	—1.03	....
Rockliffe, Ont	29.30	29.91	—.02	53.9	+ 1.6	65.4	42.4	4.02	+1.51	0.4	Prince Albert, Sask	.....	.....	.....	.....	.....	.....	.....	.....	.....	....
Ottawa, Ont	29.62	29.94	.00	57.9	+ 3.0	67.0	48.8	5.34	+2.75	.....	Battleford, Sask	28.16	29.86	—.06	54.6	+ 3.6	68.5	40.8	1.21	—0.41	....
Kingston, Ont	29.63	29.94	—.02	55.1	+ 2.2	62.0	48.2	4.86	+2.18	0.2	Kamloops, B. C	28.58	29.79	—.10	57.5	— 1.6	68.3	46.6	0.91	—0.33	....
Toronto, Ont	29.53	29.91	—.07	56.2	+ 0.3	65.6	46.9	4.57	+1.53	0.3	Victoria, B. C	29.93	30.03	+.03	52.7	+ 0.2	60.1	45.2	1.27	—0.21	....
White River, Ont	29.62	29.94	—.01	48.8	+ 3.1	61.7	35.8	5.64	+3.69	1.5	Barkerville, B. C	25.60	29.90	+.06	42.5	— 3.0	52.3	32.7	2.29	—0.23	....
Port Stanley, Ont	29.27	29.91	—.06	55.4	+ 2.3	63.8	47.1	2.24	—0.94	0.5	Hamilton, Bermuda	29.98	30.14	+.08	69.8	+ 0.4	74.6	64.9	2.62	—2.04	....
Southampton, Ont	29.20	.....	.....	54.9	+ 4.2	64.0	45.7	2.29	—0.15	.....	Dawson, Yukon	.....	.....	.....	.....	.....	.....	.....	.....	.....	....

TABLE IV.—*Heights of rivers referred to zeros of gages, May, 1908.*

Stations.	Distance to mouth of river.	Flood stage on gage.	Highest water.		Lowest water.		Mean stage.	Monthly range.	Stations.	Distance to mouth of river.	Flood stage on gage.	Highest water.		Lowest water.		Mean stage.	Monthly range.
			Height.	Date.	Height.	Date.						Height.	Date.	Height.	Date.		
Republican River.	*Miles.*	*Feet.*	*Feet.*		*Feet.*		*Feet.*	*Feet.*	*South Fork Holston River.*	*Miles.*	*Feet.*	*Feet.*		*Feet.*		*Feet.*	*Feet.*
Clay Center, Kans	42	18	12.6	29	5.4	2,3,10,11	6.6	7.2	Bluff City, Tenn	35	12	4.5	8	1.5	27,28	2.1	3.0
Smoky Hill-Kansas River.									*Holston River.*								
Abilene, Kans	254	22	3.5	4	0.0	1-3	0.9	3.5	Rogersville, Tenn	103	14	4.9	8	2.7	17	3.3	2.2
Manhattan, Kans	160	18	15.5	30	3.0	1-3	6.1	12.5	*French Broad River.*								
Topeka, Kans	87	21	16.4	30	5.6	2-4	9.4	10.8	Asheville, N. C	144	4	1.7	8	0.3	15,16,31	0.6	1.4
Missouri River.									Dandridge, Tenn	46	12	2.9	9	1.6	16-18,27	2.0	1.3
Townsend, Mont	2,504	11	7.2	31	5.0	4	5.7	2.2	*Tennessee River.*								
Fort Benton, Mont	2,285	12	6.9	29	2.1	2-4	3.8	4.8	Knoxville, Tenn	635	12	6.0	9	2.4	17-19,29	3.3	3.6
Wolfpoint, Mont	1,952	17	3.4	20	0.8	9-11	2.2	2.6	Loudon, Tenn	590	25	5.1	10	2.7	17,18	3.4	2.4
Bismarck, N. Dak	1,309	14	7.8	28	2.8	8,9	4.5	5.0	Kingston, Tenn	556	25	6.0	10	3.5	18	4.4	2.5
Pierre, S. Dak	1,114	14	6.2	30	2.0	13	3.5	4.2	Chattanooga, Tenn	452	33	12.2	11	4.8	19	7.5	7.4
Sioux City, Iowa	784	17	11.5	31	7.5	5	8.3	4.0	Bridgeport, Ala	402	24	7.4	1	3.5	19	4.6	3.9
Blair, Nebr	705	15	10.5	30,31	7.0	14,15	8.3	3.5	Guntersville, Ala	349	31	14.2	1	6.6	31	8.5	7.6
Omaha, Nebr	669	18	12.9	31	9.4	1	10.6	3.5	Florence, Ala	255	16	9.6	6	4.1	23	5.7	5.5
Plattsmouth, Nebr	641	17	7.0	30	3.7	1	4.9	3.3	Riverton, Ala	225	26	14.5	1	6.9	26	9.7	7.6
St. Joseph, Mo	481	10	8.4	31	2.1	1	4.1	6.3	Johnsonville, Tenn	95	21	16.6	8	7.0	27	10.8	9.6
Kansas City, Mo	388	21	16.7	31	8.6	2	11.9	8.1	*Ohio River.*								
Glasgow, Mo	231	21	17.7	31	8.3	4	12.4	9.4	Pittsburg, Pa	966	22	17.5	9	4.6	1	9.8	12.9
Boonville, Mo	199	20	18.3	31	8.5	4	12.6	9.8	Coraopolis, Pa	956	25	18.0	8	6.5	1	10.3	11.5
Hermann, Mo	103	24	17.1	30	8.7	5	12.6	8.4	Beaver Dam, Pa	937	27	25.8	9	9.2	1	15.2	16.6
Minnesota River.									Wheeling, W. Va	875	36	26.0	9	8.6	1	15.3	17.4
Mankato, Minn	127	18	17.5	31	5.3	12,13	9.0	12.2	Parkersburg, W. Va	785	36	28.8	10	9.4	29	16.8	19.4
St. Croix River.									Point Pleasant, W. Va	703	39	34.8	11	10.9	30	20.5	23.9
Stillwater, Minn	23	11	13.2	31	6.9	13	9.2	6.3	Huntington, W. Va	660	50	38.5	11	15.9	1	25.0	22.6
Illinois River.									Catlettsburg, Ky	651	50	39.7	11	15.4	30,31	25.1	24.3
La Salle, Ill	197	18	26.6	16	19.3	5	23.2	7.3	Portsmouth, Ohio	612	50	41.7	11	15.6	31	26.7	26.1
Peoria, Ill	135	14	21.4	20,22	15.9	1	18.8	5.5	Maysville, Ky	539	50	41.3	11	16.4	31	27.2	24.9
Onemaugh River.									Cincinnati, Ohio	499	50	44.1	9	20.0	31	30.8	24.1
Johnstown, Pa	64	7	8.0	7	2.4	1,2	3.3	5.6	Madison, Ind	413	46	38.2	9	18.4	21	27.1	19.8
Allegheny River.									Louisville, Ky	367	28	20.1	10	8.1	21	12.1	12.0
Warren, Pa	177	14	6.8	8,9	1.8	1	4.1	5.0	Evansville, Ind	184	35	37.6	12,13	19.5	25	28.1	18.1
Parker, Pa	78	20	8.5	8	3.0	27	5.6	5.5	Mount Vernon, Ind	148	35	38.5	14,15	21.3	31	29.2	17.2
Freeport, Pa	29	20	14.7	8,20	6.6	27	10.0	8.1	Paducah, Ky	47	40	37.5	17,18	24.9	31	31.2	12.6
Springdale, Pa	17	—	18.4	21	10.6	27	14.1	7.8	Cairo, Ill	1	45	45.1	20	34.3	5	39.9	10.8
Youghiogheny River.									*Neosho River.*								
Confluence, Pa	59	10	8.0	8	1.5	2	3.1	6.5	Iola, Kans	262	10	10.0	27	0.0	3	3.1	10.0
West Newton, Pa	15	23	11.9	8	2.4	1	4.7	9.5	Oswego, Kans	184	20	15.7	29	0.5	3,4	5.5	15.2
Monongahela River.									Fort Gibson, Okla	3	22	35.0	25	10.5	13	15.4	24.5
Fairmont, W. Va	119	25	23.9	5	15.2	2	17.5	8.7	*Canadian River.*								
Greensboro, Pa	81	18	20.0	5	8.1	1,2,29	11.0	11.9	Calvin, Okla	99	10	17.2	24	3.4	9	5.1	13.8
Lock No. 4, Pa	40	28	25.3	6	8.9	1	13.5	16.4	*Black River.*								
Muskingum River.									Blackrock, Ark	67	12	23.4	7	12.7	31	19.9	10.7
Zanesville, Ohio	70	25	21.2	8	9.0	29	12.1	12.2	*White River.*								
Little Kanawha River.									Calicorock, Ark	272	18	29.1	15	5.5	29	11.6	23.6
Creston, W. Va	38	20	15.0	6	2.5	29	5.1	12.5	Batesville, Ark	217	18	28.2	16	7.6	30	14.0	20.6
New-Great Kanawha River.									Clarendon, Ark	75	30	30.7	25	28.8	31	30.0	1.9
Hinton, W. Va	153	14	7.9	8	2.9	16-18	3.9	5.0	*Arkansas River.*								
Charleston, W. Va	58	30	13.0	9	5.0	19	7.2	8.0	Wichita, Kans	832	10	3.6	12	— 2.0	6-10	—1.4	5.6
Scioto River.									Tulsa, Okla	551	16	17.7	25	3.9	14	6.7	13.8
Columbus, Ohio	110	17	9.9	7	2.6	27-29	4.1	7.3	Webbers Falls, Okla	465	23	31.0	26	8.0	13	13.9	23.0
Licking River.									Fort Smith, Ark	403	22	32.7	27	8.9	12	16.8	23.8
Falmouth, Ky	30	25	13.0	8	2.0	30,31	5.8	11.0	Dardanelle, Ark	256	21	27.6	29	10.0	12	16.4	17.6
Kentucky River.									Little Rock, Ark	176	28	26.3	30	12.3	13	18.2	14.0
Beattyville, Ky	254	30	4.6	9	0.5	24,25	2.2	4.1	Pine Bluff, Ark	121	25	28.9	31	16.4	14	21.0	12.5
Frankfort, Ky	65	31	10.3	8	6.4	24	7.9	3.9	*Yazoo River.*								
Wabash River.									Greenwood, Miss	175	38	19.5	7	10.9	31	16.1	8.6
Terre Haute, Ind	171	16	20.0	10	5.7	3	13.5	14.3	Yazoo City, Miss	80	25	24.3	5,6	22.0	28-31	22.9	2.3
Mount Carmel, Ill	75	15	24.9	13	8.7	31	18.2	16.2	*Ouachita River.*								
Cumberland River.									Camden, Ark	304	39	36.6	19	13.5	13	25.7	23.1
Burnside, Ky	518	50	13.1	8	2.2	31	6.3	10.9	Monroe, La	122	40	35.6	22-25	29.0	4	32.2	6.6
Celina, Tenn	383	45	17.4	9	4.8	31	10.5	12.6									
Carthage, Tenn	308	40	14.5	10	5.0	25	9.4	9.5	*Red River*								
Nashville, Tenn	193	40	21.7	1	10.9	26	15.1	10.8	Denison, Tex	768	22	32.5	26	2.3	10	8.9	30.2
Clarksville, Tenn	126	43	26.0	1	10.0	26	17.5	16.0	Arthur City, Tex	688	27	43.2	28	8.7	11	18.5	34.5
Clinch River.									Fulton, Ark	515	28	31.0	20	14.7	13	25.9	16.3
Speers Ferry, Va	156	20	2.4	21	0.5	18,19	1.2	1.9	Shreveport, La	327	29	27.0	27	19.8	12	24.3	7.2
Clinton, Tenn	52	25	9.7	10	5.4	19,20	6.8	4.3	Alexandria, La	118	33	36.3	31	30.5	15	33.0	5.8

TABLE IV.—*Heights of rivers referred to zeros of gages*—Continued.

Stations.	Distance to mouth of river.	Flood stage on gage.	Highest water.		Lowest water.		Mean stage.	Monthly range.
			Height.	Date.	Height.	Date.		
Mississippi River.	*Miles.*	*Feet.*	*Feet.*		*Feet.*		*Feet.*	*Feet.*
Fort Ripley, Minn	2,082	10	8.8	31	5.3	10	6.4	3.5
St. Paul, Minn.	1,954	14	12.5	31	5.6	12	7.7	6.9
Red Wing, Minn.	1,914	14	10.2	31	5.5	15-17	7.1	4.7
Reeds Landing, Minn.	1,884	12	9.2	31	5.1	15	6.6	4.1
La Crosse, Wis.	1,819	12	10.1	31	6.5	17, 18	8.0	3.6
Prairie du Chien, Wis.	1,759	18	11.4	31	7.5	1, 2	9.4	3.9
Dubuque, Iowa	1,699	18	11.8	11, 31	8.0	1	10.2	3.8
Clinton, Iowa	1,629	16	10.8	13	7.4	1	9.4	3.4
Leclaire, Iowa	1,609	10	6.5	13, 14	4.3	1, 2	5.5	2.2
Davenport, Iowa	1,593	15	10.2	14, 16	7.0	1	8.9	3.2
Muscatine, Iowa	1,562	16	11.7	16-18	8.2	1, 2	10.3	3.5
Galland, Iowa	1,472	8	6.6	29	4.0	1, 2	5.3	2.6
Keokuk, Iowa	1,463	15	15.0	29	6.7	1, 2	9.9	8.3
Warsaw, Ill	1,458	18	18.4	29	9.7	1	13.0	8.7
Hannibal, Mo	1,402	13	17.4	31	7.6	1, 2	11.2	9.8
Grafton, Ill	1,306	23	20.2	31	11.5	3	15.7	8.7
St. Louis, Mo	1,264	30	27.5	31	15.2	4	21.0	12.3
Chester, Ill	1,189	30	23.1	31	13.7	4	19.3	9.4
Cape Girardeau, Mo.	1,128	28	27.2	31	18.9	4	24.2	8.3
New Madrid, Mo.	1,008	34	36.1	21	28.4	5, 6	32.4	7.7
Memphis, Tenn	843	33	35.3	25, 26	27.7	8	31.7	7.6
Helena, Ark.	767	42	44.4	26, 27	37.2	9	40.9	7.2
Arkansas City, Ark.	635	42	49.8	31	45.6	18	47.6	4.2
Greenville, Miss.	595	42	44.4	31	39.8	13-15	42.0	4.6
Vicksburg, Miss.	474	45	47.5	1, 2	45.4	18	46.5	2.1
Natchez, Miss.	373	46	48.0	6, 7	46.7	17-22	47.3	1.3
Baton Rouge, La.	240	35	37.8	31	36.8	1, 2, 22, 23	37.2	1.0
Donaldsonville, La	188	28	30.1	31	29.3	1-3, 23-25	29.6	0.8
New Orleans, La.	108	16	19.1	6, 17	18.3	23	18.7	0.8
Atchafalaya River.								
Simmesport, La.	127	33	43.4	31	41.9	1	42.7	1.5
Melville, La.	103	31	38.6	30, 31	37.8	1	38.3	0.8
Morgan City, La	19	33	5.5	17	3.8	9	4.8	1.7
Hudson River.								
Troy, N. Y.	154	14	9.5	3	5.7	30	7.7	3.8
Albany, N. Y.	147	12	10.3	2	3.8	26	6.3	6.5
Delaware River.								
Hancock (E. Branch), N. Y.	287	12	6.4	8	3.8	20, 22	4.7	2.6
Hancock (W. Branch), N. Y.	287	10	7.0	8	3.5	30	4.7	3.5
Port Jervis, N. Y.	215	14	6.4	8	1.2	30	3.3	5.2
Phillipsburg, N. J.	146	26	9.7	9	3.5	30	5.6	6.2
Trenton, N. J.	92	18	7.4	9	3.1	6, 7, 29, 30	4.1	4.3
North Branch Susquehanna.								
Binghamton, N. Y.	183	14	8.2	9	2.6	30	4.5	5.6
Wilkes-Barre, Pa.	69	17	15.7	9	5.2	31	9.0	10.5
West Branch Susquehanna.								
Williamsport, Pa.	39	20	10.9	21	4.0	1	7.3	6.9
Susquehanna River.								
Harrisburg, Pa.	69	17	11.0	9	3.7	1	6.8	7.3
Shenandoah River.								
Riverton, Va.	58	22	7.1	24	— 0.9	1-6	1.8	8.0
Potomac River.								
Cumberland, Md.	290	8	8.8	22	3.2	1-4	4.9	5.6
Harpers Ferry, W. Va.	172	18	16.5	23	1.0	3-5	7.1	15.5
James River.								
Lynchburg, Va.	260	20	7.2	8	2.0	18	3.2	5.2
Columbia, Va.	167	18	13.0	9	5.8	18, 19	7.7	7.2
Richmond, Va.	111	10	3.9	10, 22	0.7	17	1.7	3.2
Roanoke River.								
Clarksville, Va	196	12	3.4	21	0.8	31	1.8	2.6
Weldon, N. C.	129	30	19.6	22	12.1	31	13.8	7.5
Tar River.								
Greenville, N. C.	21	22	7.6	26	3.9	18	5.0	3.7
Deep River.								
Moncure, N. C.	171	25	9.0	1	7.0	18, 31	7.9	2.0
Cape Fear River.								
Fayetteville, N. C.	112	38	8.4	2	3.5	18	5.6	4.9
Pedee River.								
Cheraw, S. C.	149	27	8.0	21	2.3	19	4.2	5.7
Smiths Mills, S. C.	51	16	11.9	2, 3	4.8	20	8.4	7.1
Lynch Creek.								
Effingham, S. C.	35	12	8.6	1	4.0	17, 18	5.1	4.6
Black River.								
Kingstree, S. C.	45	12	7.7	4	3.0	24, 25	5.2	4.7
Catawba-Wateree River.								
Mount Holly, N. C.	143	15	2.2	19	1.8	5-13, 26-31	1.9	0.4
Catawba, S. C.	107	11	4.4	21	2.4	7	3.2	2.0
***Catawba-Wateree River*-Con.**								
Camden, S. C.	37	24	11.9	22	6.2	17	7.8	5.7
Congaree River.								
Columbia, S. C.	52	15	2.4	20	1.0	17	1.7	1.4
Santee River.								
Ferguson, S. C.	82	12	12.6	1, 2	8.0	19	10.3	4.6
Savannah River.								
Calhoun Falls, S. C.	347	15	4.9	8	3.2	28	3.8	1.7
Augusta, Ga.	268	32	12.4	1	8.5	25, 28	9.8	3.9
Oconee River.								
Dublin, Ga	79	30	20.8	1	2.0	27, 29, 30	5.8	18.8
Ocmulgee River.								
Macon, Ga.	134	18	13.0	31	4.6	24	6.2	8.4
Abbeville, Ga.	51	11	17.5	2	5.9	27, 28	9.1	11.6
Flint River.								
Montezuma, Ga.	152	20	16.5	1	5.1	19, 30	7.1	11.4
Albany, Ga.	99	20	27.9	3	3.8	29	9.8	24.1
Bainbridge, Ga.	22	22	25.3	5	8.3	27, 28	13.8	17.0
Chattahoochee River.								
West Point, Ga	174	20	6.6	8	3.8	25, 26	4.6	2.8
Eufaula, Ala	90	40	28.2	1	5.0	26, 27	8.5	23.2
Alaga, Ala.	30	25	36.7	1	7.5	26	11.7	29.2
Coosa River.								
Rome, Ga.	266	30	7.8	8	2.5	25	3.5	5.3
Gadsden, Ala.	162	22	7.5	9	2.9	25	4.5	4.6
Lock No. 4, Ala.	113	17	6.0	10	2.5	26	3.9	3.5
Wetumpka, Ala	12	45	21.5	1	7.1	26	10.6	14.4
Alabama River.								
Montgomery, Ala.	323	35	23.8	1	4.9	26	8.5	18.9
Selma, Ala	246	35	34.0	1	6.4	27	12.6	27.6
Black Warrior River.								
Tuscaloosa, Ala.	90	43	46.4	7	8.8	4	19.3	37.6
Tombigbee River.								
Columbus, Miss	316	33	17.0	10	— 0.5	30	6.6	17.5
Demopolis, Ala.	168	35	43.1	12	11.2	31	29.7	31.9
Pascagoula River.								
Merrill, Miss.	78	20	19.6	13	7.5	31	16.3	12.1
Pearl River.								
Columbia, Miss.	110	18	21.0	11	10.8	5	16.5	10.2
Sabine River.								
Logansport, La.	315	25	32.9	18	18.7	4	23.2	14.2
Neches River.								
Beaumont, Tex.	18	10	7.2	31	1.4	9	3.2	5.8
Trinity River.								
Dallas, Tex.	320	25	52.6	25	8.4	12	21.3	44.2
Long Lake, Tex.	211	35	47.3	31	23.4	13	38.7	21.9
Liberty, Tex	20	25	27.6	21-23, 25, 26	25.6	6-8	26.7	2.0
Brazos River.								
Waco, Tex.	285	22	36.7	24	4.3	11	11.6	32.4
Hempstead, Tex	140	40	39.5	30	6.8	13	23.4	32.7
Booth, Tex	61	39	39.0	1	10.5	12	24.4	28.5
Colorado River.								
Austin, Tex.	214	18	17.0	25	1.7	14	5.3	15.3
Columbus, Tex.	98	24	33.8	30	8.2	14	16.8	25.6
Red River of the North.								
Moorhead, Minn	284	26	10.2	22	8.6	12-17	9.1	1.6
Rio Grande.								
El Paso, Tex.	1,030	14	12.3	26, 28	11.1	7	11.6	1.2
San Marcial, N. Mex.	1,233	11	11.1	22, 23, 25	10.1	1, 3, 9	10.6	1.0
Snake River.								
Lewiston, Idaho	144	24	10.5	8	7.1	23	8.4	3.4
Riparia, Wash	67	30	11.2	9	7.7	25	9.0	3.5
Columbia River.								
Wenatchee, Wash	473	40	30.0	31	19.0	1	25.7	11.0
Umatilla, Oreg	270	25	15.7	31	11.2	1	14.0	4.5
The Dalles, Oreg.	166	40	24.9	31	17.1	2	21.7	7.8
Willamette River.								
Albany, Oreg.	118	20	6.7	21	3.8	15, 31	4.7	2.9
Portland, Oreg.	12	15	14.3	21, 22	10.6	2-4	12.6	3.7
Sacramento River.								
Red Bluff, Cal.	265	23	6.7	19	3.0	11, 13, 14, 18	3.6	3.7
Colusa, Cal	156	28	10.6	21	7.6	31	8.7	3.0
Knights Landing, Cal.	99	18	10.6	21	8.6	14, 15	9.4	2.0
Sacramento, Cal.	64	25	17.1	3	15.3	15	16.2	1.8
San Joaquin River.								
Pollasky, Cal.	203	10	3.2	1	0.7	19	1.7	2.5
Firebaugh, Cal	148	14	5.5	2, 3	1.4	20	3.0	4.1
Lathrop, Cal.	49	14	12.9	4	7.3	20	10.0	5.6

Honolulu, T. H., latitude 21° 19′ north, longitude 157° 52′ west; barometer above sea, 38 feet; gravity correction, —0.057 inch, applied. May, 1908.

Day.	Pressure, in inches.*		Air temperature, degrees Fahrenheit.				Moisture.				Wind, in miles per hour.				Precipitation, inches.		Clouds.					
							8 a. m.		8 p. m.		8 a. m.		8 p. m.				8 a. m.			8 p. m.		
	8 a. m.	8 p. m.	8 a. m.	8 p. m.	Maximum.	Minimum.	Wet.	Relative humidity.	Wet.	Relative humidity.	Direction.	Velocity.	Direction.	Velocity.	8 a. m.	8 p. m.	Amount.	Kind.	Direction, from.	Amount.	Kind.	Direction, from.
							°	%	°	%												
1	30.10	30.11	75.0	74.0	79	70	64.0	54	64.5	60	ne.	6	e.	9	0.00	0.00	3	Ci.	sw.	5	S.	ne.
2	30.13	30.12	75.0	73.5	79	71	66.0	62	67.0	71	ne.	12	e.	9	0.00	0.00	4 2	Ci. Cu.	w. e.	6	S.	ne.
3	30.16	30.13	74.1	72.0	79	71	67.8	72	68.0	82	ne.	8	e.	6	T.	T.	2 7	A.-s. S.-cu.	0 e.	10	N.	e.
4	30.13	30.08	74.8	72.5	77	72	67.0	67	68.0	80	ne.	5	ne.	5	T.	0.00	7 3	A.-s. S.-cu.	0 e.	10	S.	ne.
5	30.07	30.05	74.5	73.0	79	71	67.0	68	67.0	73	e.	6	ne.	11	T.	0.00	8	S.-cu.	e.	6	Cu.	ne.
6	30.07	30.02	75.4	73.0	80	71	67.0	64	67.0	73	e.	12	e.	10	0.00	0.00	5 2	A.-cu. Cu. N.	e. e.	3	Cu.	ne.
7	30.07	30.09	76.6	74.0	81	70	68.0	64	68.0	74	ne.	5	e.	10	0.00	0.00	Few	Cu.	ne.	9	S.	ne.
8	30.15	30.12	76.0	74.0	81	72	68.4	68	68.0	74	e.	6	se.	3	0.00	0.00	9	S.-cu.	e.	10	A.-s.	nw.
9	30.15	30.11	75.0	72.0	79	70	66.0	62	66.0	73	e.	12	ne.	9	T.	0.08	8 2	A.-s. S.-cu.	0 ne.	10	S.	ne.
10	30.12	30.09	74.0	73.0	79	70	66.0	65	66.0	69	e.	17	ne.	9	0.02	0.00	8	S.-cu.	e.	7	Cu.	ne.
11	30.10	30.10	75.1	73.0	80	70	66.4	63	66.0	69	n.	6	e.	8	0.00	0.00	2	Cu.	n.	1	Cu.	ne.
12	30.08	30.08	76.0	73.0	80	71	67.0	62	68.0	78	e.	9	e.	6	0.00	T.	2 2	Ci. Cu.	w. e.	5	Cu.	ne.
13	30.07	30.04	76.5	72.5	79	68	68.5	66	67.0	75	n.	2	e.	3	0.00	0.00	7	S.-cu.	e.	9 1	A.-s. A.-s.	nw. ne.
14	30.04	30.02	75.0	74.0	80	68	69.0	74	67.0	69	ne.	2	ne.	5	0.00	0.00	1 6	A.-s. Cu.	0 ne.	6 1 6	A.-s. Cu. A.-cu.	sw. e. sw.
15	30.04	30.05	77.0	74.5	81	71	68.1	63	68.0	72	ne.	8	ne.	10	0.00	T.	4 3	Ci.-cu. Cu.	sw. e.	2 1 1	A.-s. A.-s. S.	nw. ne. e.
16	30.06	30.09	76.0	73.5	80	71	66.0	60	67.0	71	ne.	5	n.	4	0.00	0.00	2	Cu.	e.	8	S.	ne.
17	30.12	30.11	76.1	73.0	80	71	68.2	64	66.0	69	ne.	6	ne.	4	0.00	0.00	2 2	A.-cu. S.-cu.	e. e.	Few	S.-cu.	ne.
18	30.13	30.12	77.0	74.0	80	72	67.0	62	66.0	65	ne.	4	e.	6	0.00	0.00	4	Cu.	e.	1	Cu.	ne.
19	30.13	30.10	75.0	73.0	79	70	66.1	61	66.0	69	ne.	12	ne.	15	T.	0.00	6	S.-cu.	e.	0	0	0
20	30.09	30.03	77.0	74.0	80	72	65.0	58	66.5	67	e.	12	e.	12	0.00	0.00	1	Cu.	e.	1	S.-cu.	ne.
21	30.01	30.01	75.0	73.5	80	70	64.2	57	66.0	67	ne.	9	ne.	12	0.00	0.00	4	Cu.	e.	0	0	0
22	30.04	30.10	76.0	74.0	81	70	66.5	61	67.0	69	ne.	9	ne.	6	0.00	0.00	1	Cu.	e.	Few	Cu.	ne.
23	30.10	30.10	73.5	75.0	80	68	68.0	66	67.5	68	e.	5	ne.	6	0.19	0.02	7	S.-cu.	e.	3	S.	ne.
24	30.12	30.08	77.0	74.0	82	71	68.2	63	68.0	74	e.	4	ne.	3	T.	0.00	3 1	A.-cu. S.-cu.	e. 0	Few	Cu.	ne.
25	30.06	30.06	76.0	74.0	81	71	69.0	66	67.0	69	e.	8	e.	9	T.	T.	7	S.-cu.	e.	6	S.	e.
26	30.07	30.08	76.0	74.0	80	71	67.0	62	67.0	69	e.	12	e.	15	0.02	0.00	4	Cu.	e.	6	S.	e.
27	30.15	30.12	75.0	74.0	80	71	67.0	63	65.0	61	e.	9	ne.	6	T.	0.00	1 7	Ci.-s. S.-cu.	0 e.	3	Cu.	e.
28	30.13	30.13	75.0	71.0	79	68	65.0	59	66.5	79	e.	8	ne.	12	0.00	0.02	4 2	A.-cu. S.-cu.	0 ne.	10	N.	ne.
29	30.12	30.10	72.0	74.0	80	68	66.3	63	66.0	65	e.	13	ne.	15	T.	T.	8	S.-cu.	ne.	8	S.	ne.
30	30.10	30.08	75.0	74.0	79	69	67.5	64	66.0	65	e.	10	e.	8	T.	0.00	2 2	A.-cu. Cu.	0 e.	Few	A.-s.	0
31	30.08	30.05	73.2	74.0	80	71	66.4	63	67.0	69	ne.	7	ne.	4	T.	T.	2 5	A.-cu. N.	0 e.	2	A.-s.	sw.
Mean	30.096	30.083	75.3	73.5	79.8	70.3	66.9	62.3	66.8	70.6	e.	8.0	ne.	8.1	0.23	0.12	5.6	S.-cu.	e.	5.1	Cu.	ne.

Observations are made at 8 a.m. and 8 p. m., local standard time, which is that of 157° 52′ west, and is 5h and 30m slower than 75th meridian time. *Pressure values are reduced to sea level and standard gravity.

RAINFALL IN JAMAICA.

Thru the kindness of Mr. Maxwell Hall, meteorologist to the government of Jamaica and now in charge of the meteorological service of that island, we have received the following data:

Comparative table of rainfall.

[Based upon the average stations only.]

MAY, 1908.

Divisions.	Relative area.	Number of stations.	Rainfall.	
			1908.	Average.
	Per cent.		*Inches.*	*Inches.*
Northeastern division	25	21	3.40	14.46
Northern division	22	49	3.20	7.27
West-central division	26	19	9.48	13.20
Southern division	27	30	3.61	9.01
Means	100	....	4.92	10.98

The rainfall over the island for May, 1908, was well below the average; the forecast of "about the average" was not verified.

The maximum rainfall recorded was 17.66 inches at Great Valley, Hanover, in the west-central division; no rain fell at Llandovery in the northern division; and at a dozen other stations under 1 inch fell for the whole month. At Georgetown, Grand Cayman, for May, 1908, 5.31 inches fell on eleven days; 1.16 inches fell on May 26.

Chart I. Hydrographs for Seven Principal Rivers of the United States, May, 1908.

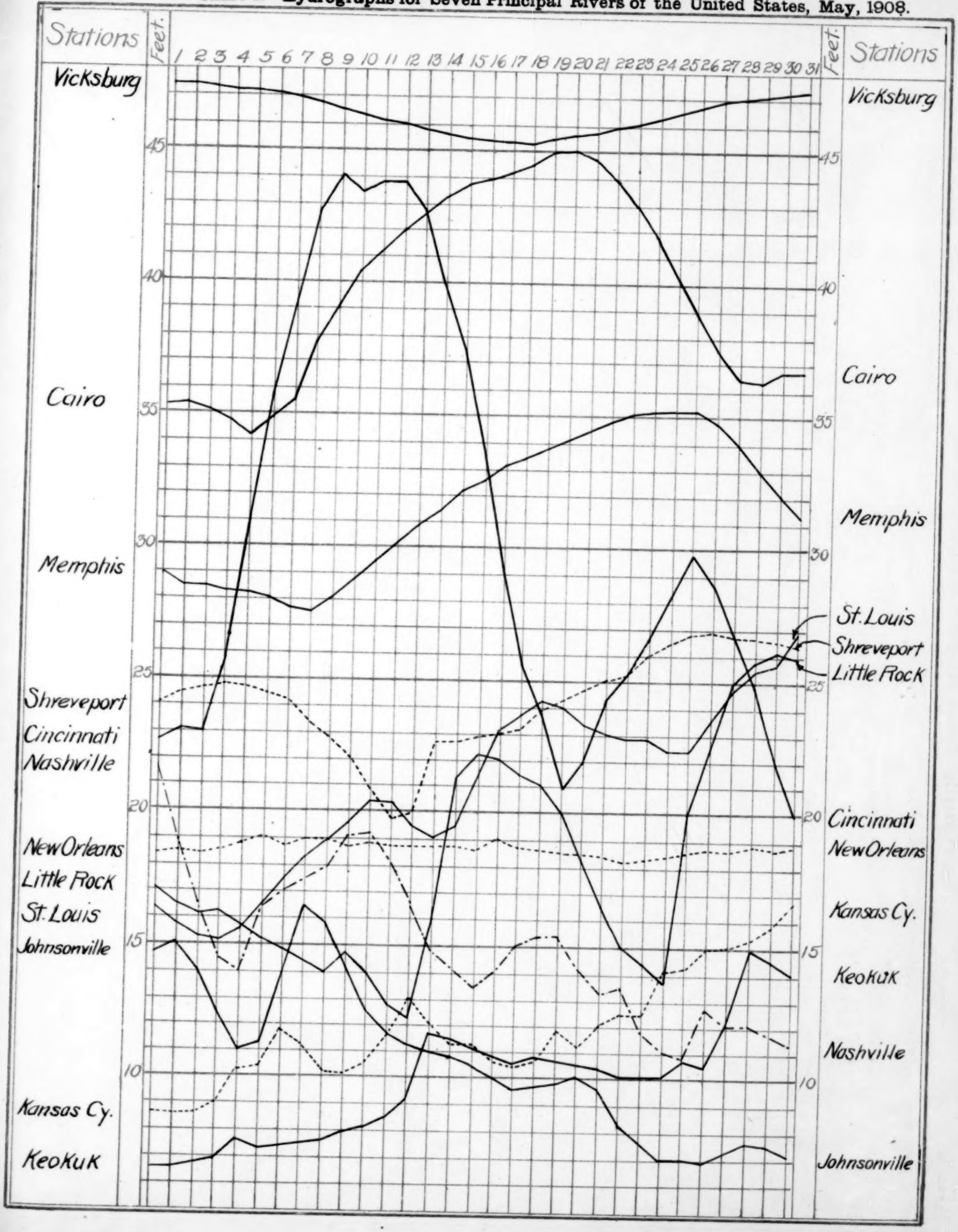

Chart II. Tracks of Centers of High Areas, May, 1908.

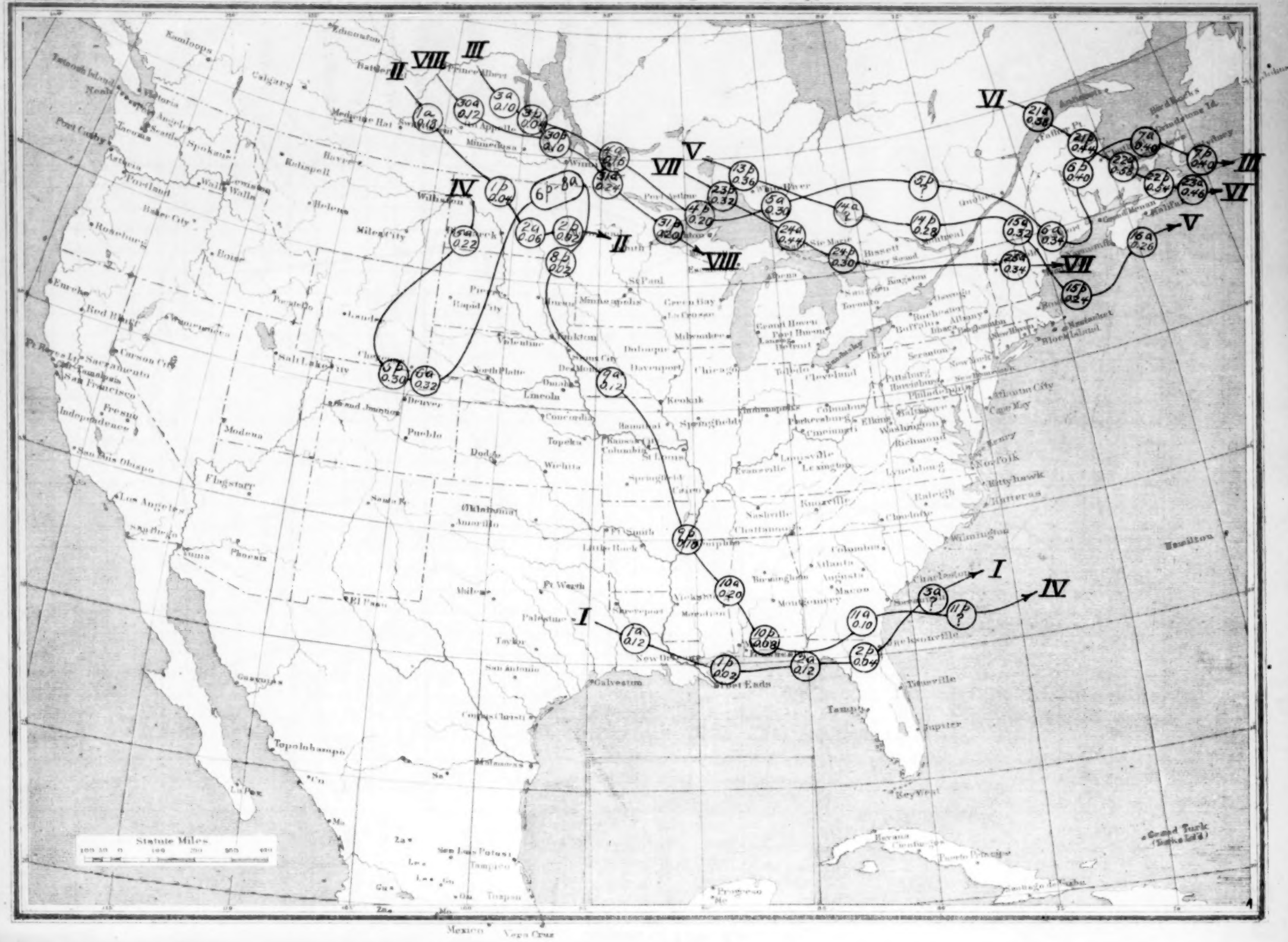

Chart III. Tracks of Centers of Low Areas, May, 1908.

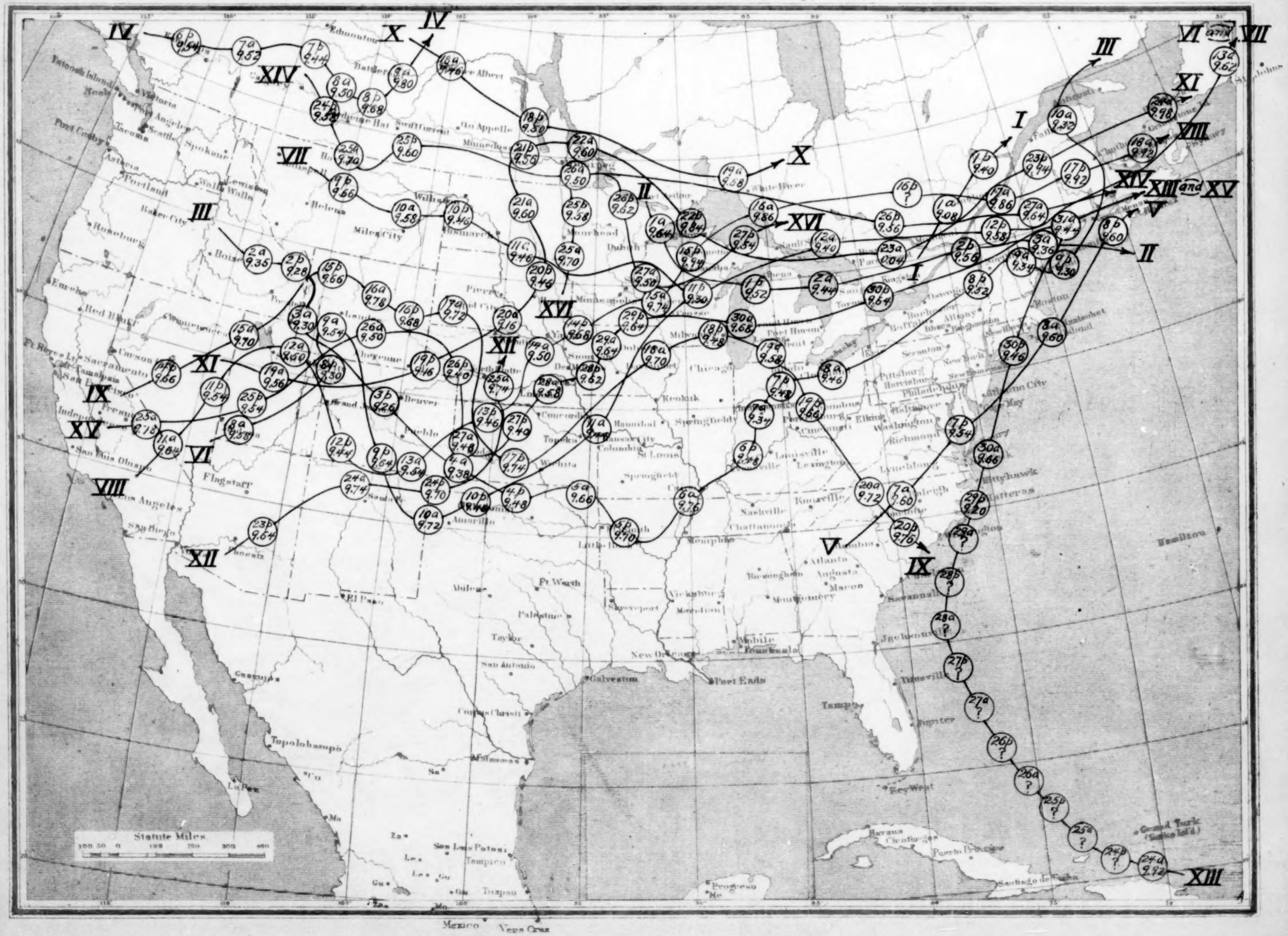

Chart IV. Total Precipitation, May, 1908.

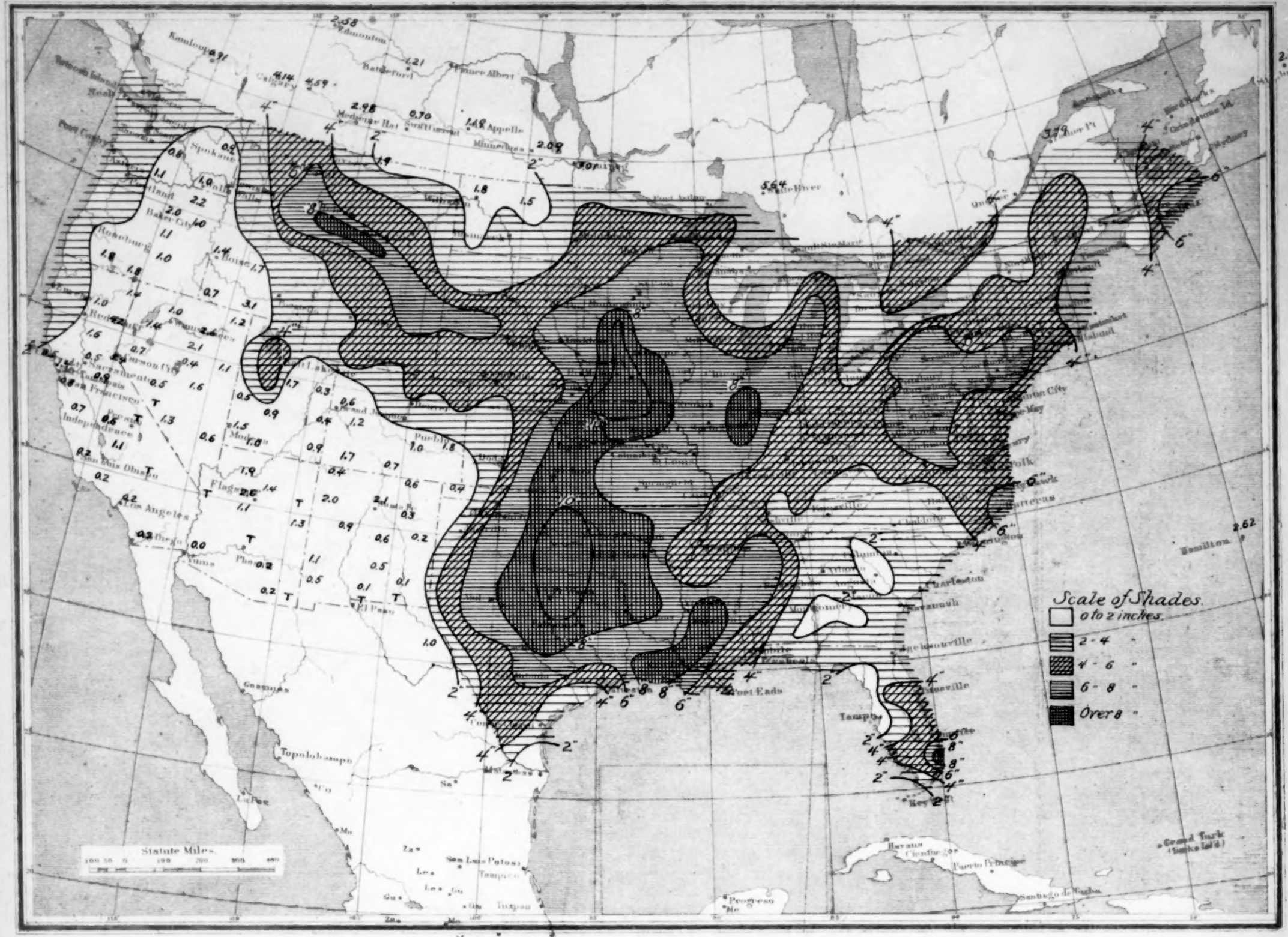

Chart V. Percentage of Clear Sky between Sunrise and Sunset, May, 1908.

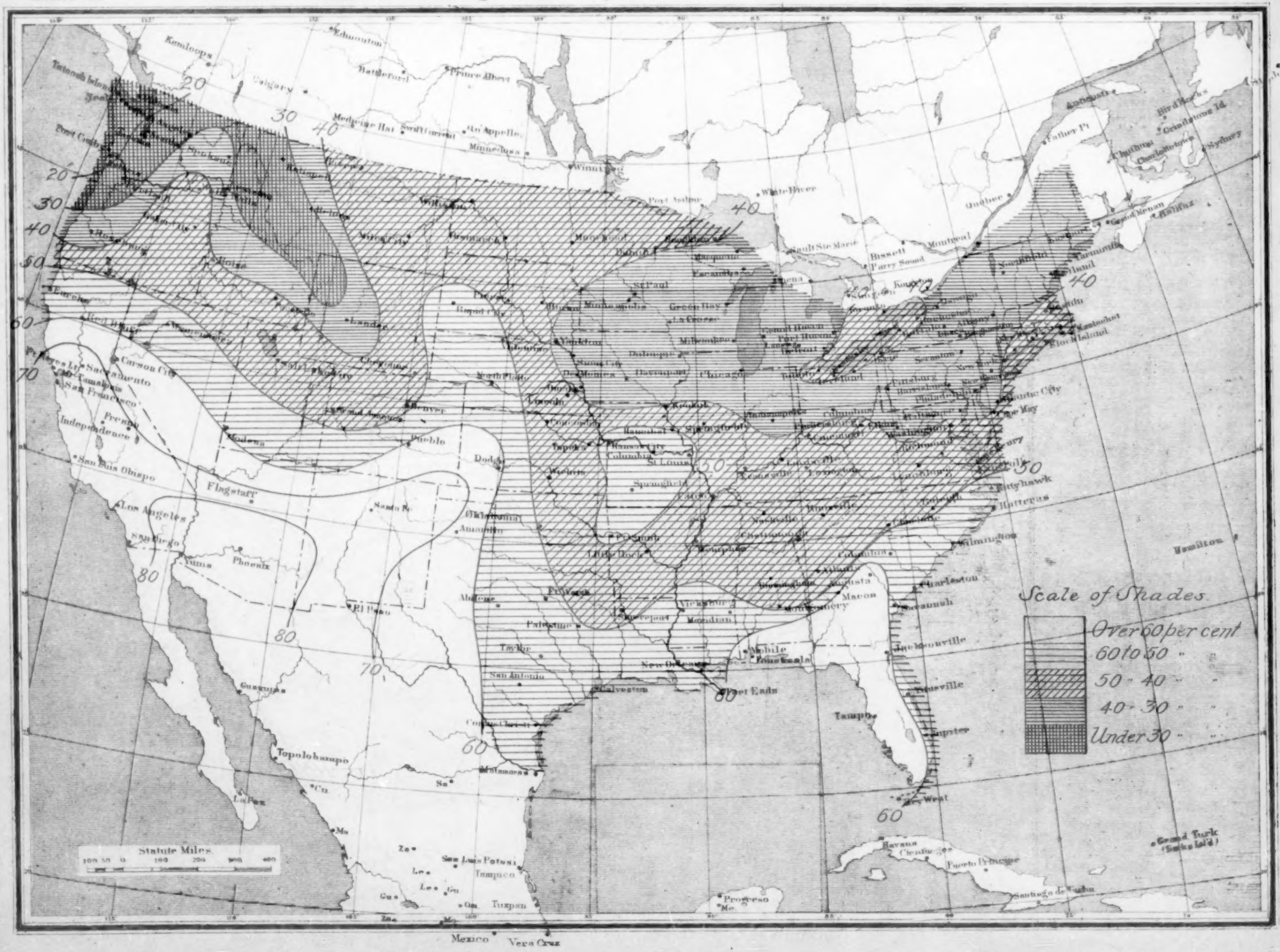

Chart VI. Isobars and Isotherms at Sea Level; Prevailing Winds, May, 1908.

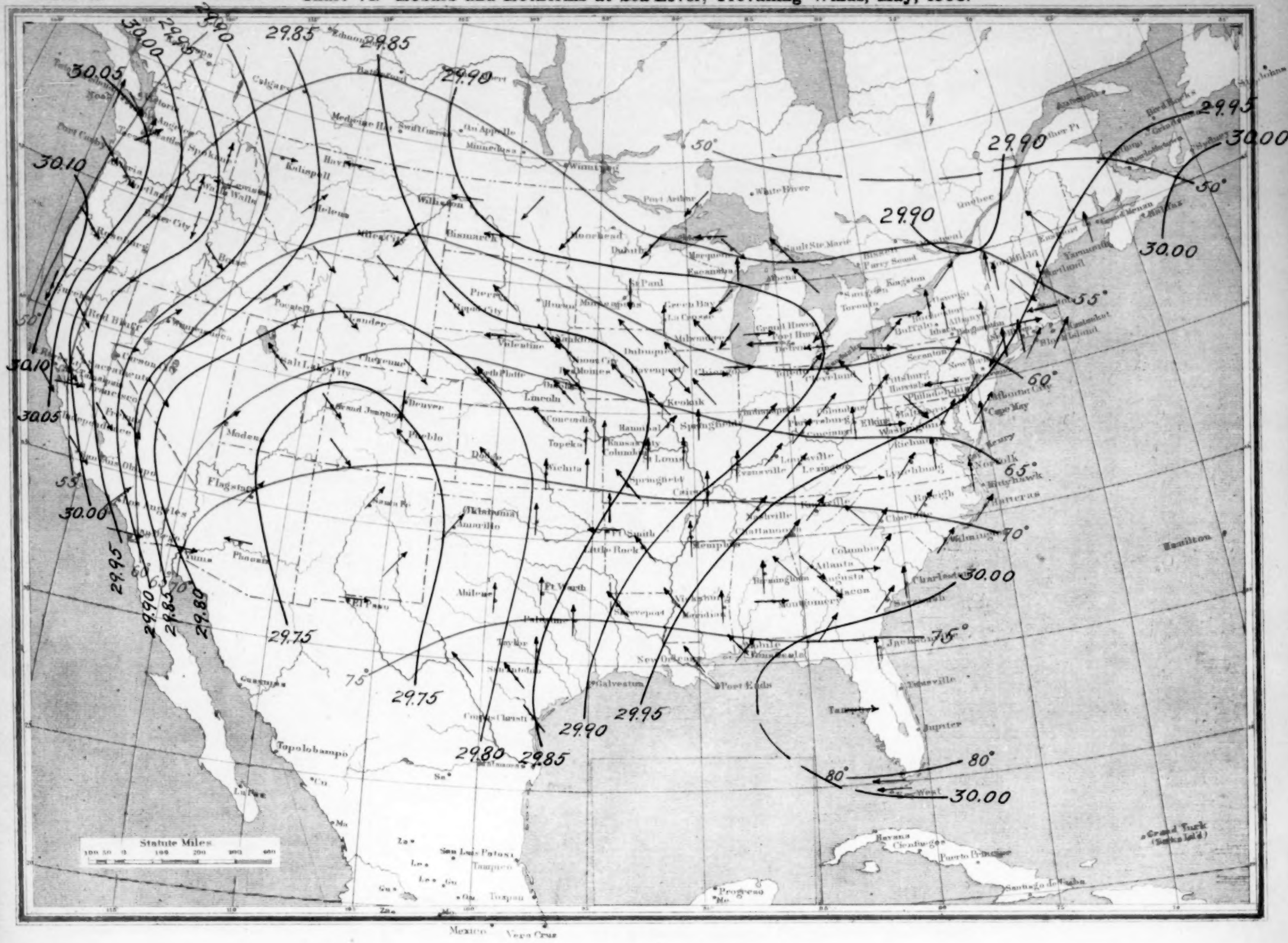
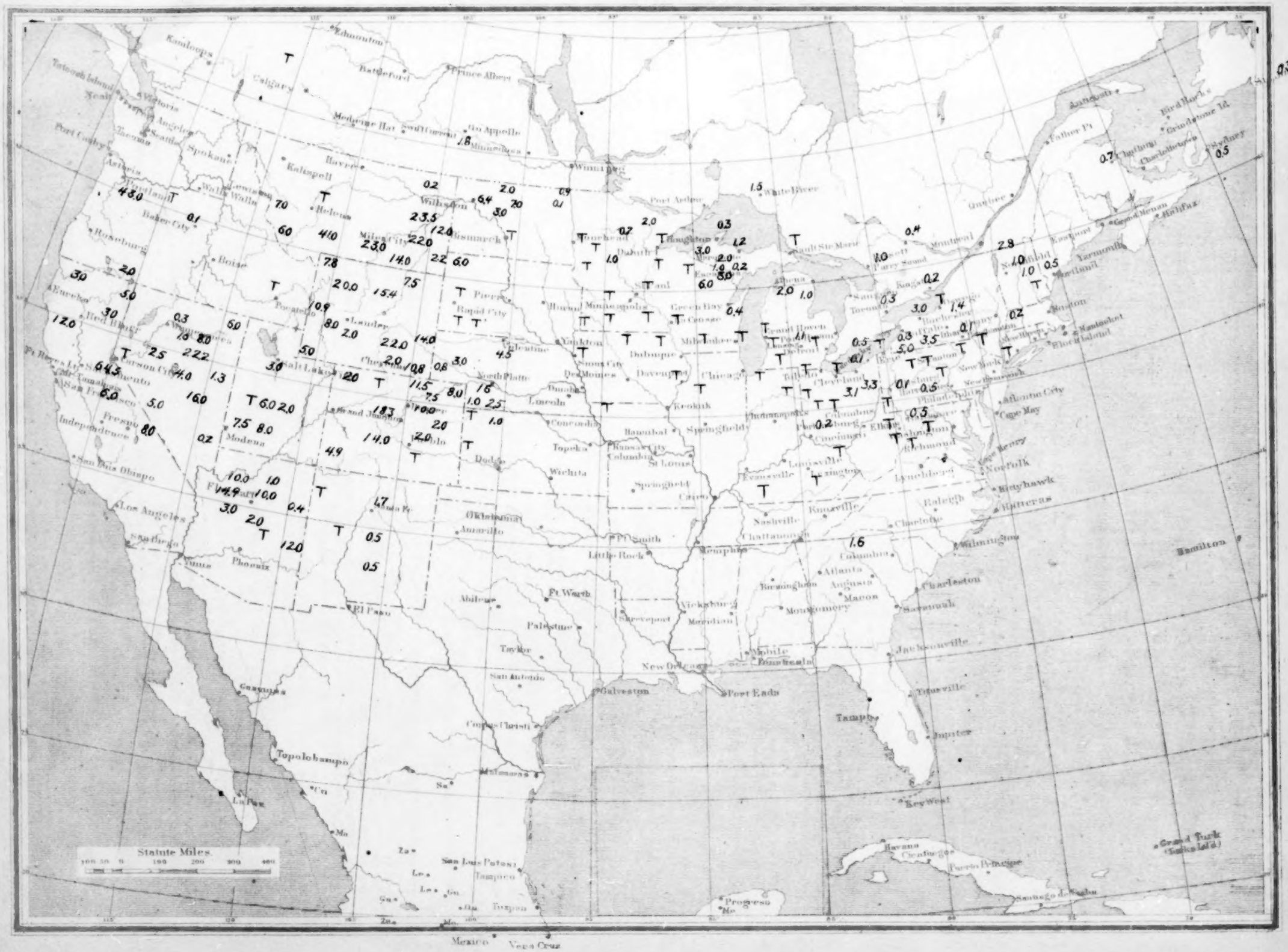
Chart VII. Total Snowfall for May, 1908.